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AMERICAN JOURNAL OF OPHTHALMOLOGY

THIRD SERIES FOUNDED BY EDWARD JACKSON

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DEPARTMENTS

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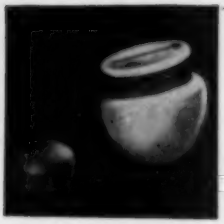

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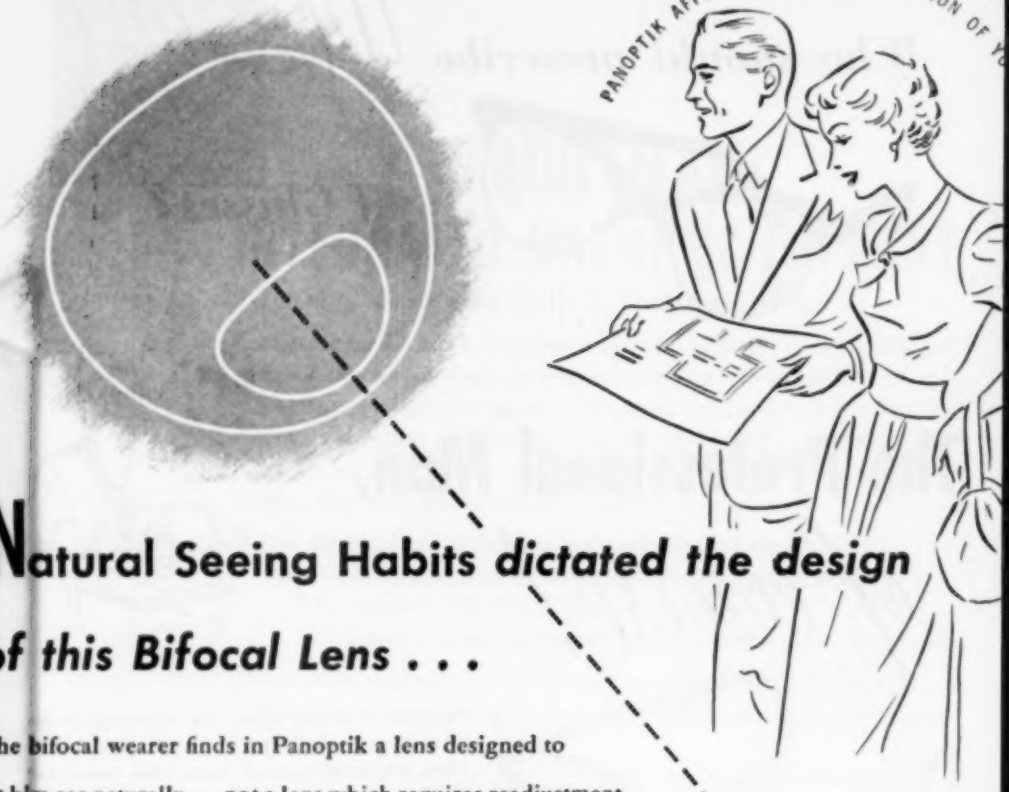

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Table 2 gives the approximate range through the intermediate portions of the tri-focals. It should be understood that both Table 1 and Table 2 give approximations and not exact distances. The accommodation is such a variable factor that only approximations are possible. However, the distances given in the tables are correct enough for most cases.

TABLE #1 READING DISTANCES

ADD FOR READING	CLOSE POINT	FAR POINT
+ 1.00	11 INCHES	39 INCHES
+ 1.50	11 INCHES	29 INCHES
+ 2.00	11 INCHES	20 INCHES
+ 2.50	12 INCHES	17 INCHES
+ 3.00	12 INCHES	14 INCHES

TABLE #2 INTERMEDIATE DISTANCE

READING ADD	INTERMEDIATE ADD	INTERMEDIATE FAR POINT
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+ 3.00	+ 1.37	27 INCHES

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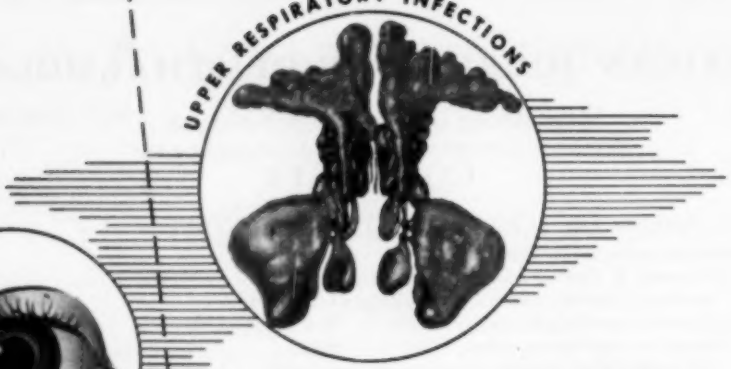

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AMERICAN JOURNAL OF OPHTHALMOLOGY

VOLUME 33 NOVEMBER, 1950 NUMBER 11

*Symposium on Secondary Glaucoma**

FOREWORD

F. BRUCE FRALICK, M.D.
Ann Arbor, Michigan

At the present time medicine knows of no way to prevent glaucoma. If recognized early, glaucoma can usually be kept under control by the continuous use of miotics or the institution of surgery, but even then the sight already lost is gone forever.

The main problem is that the symptoms of early glaucoma are vague and usually pass unnoticed, while the elevated intraocular pressure continues to cause a progressive optic atrophy. When the victim finally does suspect there is something wrong, it is often too late. The only way to be safe from glaucoma is to have an adequate examination for its presence by a competent ophthalmologist at periodic intervals after 40 years of age. As ophthalmologists, we must suspect every patient seen in our offices and clinics of having glaucoma and check the intraocular pressure with the tonometer. If every patient seen by us in this age group was so examined, especially after the use of mydriatics, in many unsuspected instances glaucomatous eyes would be discovered.

Each year, as medical science stretches man's life span, glaucoma becomes a more serious problem because it usually strikes older age groups and is thus finding more and more victims. In 1950 it is estimated the disease will be responsible for 11 percent of the 22,100 new cases of blindness in the United States.

Recently the Philadelphia Society for the Prevention of Blindness examined 2,550 adults over 40 years of age. They found that 1.7 percent of these persons had glaucoma but didn't know it. The National Society for the Prevention of Blindness, after projecting these findings for the population over 40 years of age for the entire United States, states that 800,000 Americans now have glaucoma without knowing it. These people will slowly but surely go blind unless the disease can be discovered early and adequate treatment can be instituted.

In formulating this short symposium on glaucoma it was realized that the entire subject could not be covered in the time allotted. We have, I believe, gathered together some of the nation's foremost teachers and clinicians who are especially interested in glaucoma problems. They will present their concept of glaucoma as far as it pertains to their special assignments.

University Hospital.

* Presented at the Pan-American Association of Ophthalmology and the National Society for the Prevention of Blindness Conference, Miami Beach, Florida, March, 1950.

Symposium on Secondary Glaucoma

SECONDARY GLAUCOMA DUE TO CATARACT

RALPH O. RYCHENER, M.D.
Memphis, Tennessee

The conditions under this general heading may be subdivided into: (1) Intumescent cataract which includes those of toxic and traumatic origin; (2) hypermature or morgagnian cataract; (3) exfoliative cataract or glaucoma capsulare; (4) subluxated lenses as in trauma, arachnodactyly, or other congenital malformations.

INTUMESCENT CATARACT

Von Graefe, in 1869, first recognized the secondary rise in intraocular pressure which may follow rapid swelling of the lens. It occurs in rapidly developing intumescent cataracts of the senile type, in which it is often fleeting and unrecognized, in toxic cataracts such as those produced by naphthalene or dinitrophenol, or in traumatic cataract, as after perforating injury or discission of congenital or juvenile cataracts.

The sequence of intraocular events is a forward pressure of the anterior portion of the ciliary body and root of the iris with mechanical obstruction of the filtration angle. When the lens capsule is ruptured, the trabecular spaces are additionally blocked with soft lens cortex. The mechanical pressure of the former and the irritative iridocyclitis of the latter probably excite neurovascular reflexes which precipitate the secondary glaucoma. In this situation, drugs are of little value, although miotics may be helpful until surgery becomes convenient for the patient.

In intumescent senile cataract, a combined intracapsular extraction is a safe procedure. Some surgeons, however, prefer the two-stage procedure of preliminary iridectomy followed later by cataract extraction.

Toxic cataracts are managed according to the age of the patient and the maturity of the cataract. In older individuals they can usually be handled as simple intumescent cataracts. In younger people, discission and linear extraction is a safer procedure. Toxic cataract is now seen infrequently in comparison with the incidence during the era when dinitrophenol, as a weight-reducing drug, was popular. However, one sees with some relative frequency, an intumescent type of cataract, due to the metabolic changes of tetany, induced by the surgical removal of the parathyroid glands with the thyroids for the relief of thyrotoxicosis. Occasionally in a patient with diabetes, similar lens changes are observed. Surgical removal yields excellent visual results.

In traumatic or discission cataract, complicated by secondary glaucoma, a linear incision high in the cornea and without iridectomy will suffice. Once the bulk of the lens cortex is removed, the aqueous manages resorption of the remainder.

HYPERMATURE OR MORGAGNIAN CATARACT

This type of cataract was once so common and widespread as to be considered a normal form of cataract. It is now infrequent and really a clinical rarity, due to the universal surgical treatment for cataract and, in particular, to the increasing frequency of intracapsular extraction of immature cataracts.

Due to lysis of the lens fibers, vacuoles and morgagnian globules coalesce to form a liquid or pultaceous cortex with a hard, movable nucleus, which may sink to the inferior portion of the capsular bag. The cortex may then lose its watery content by diffusion and the lens may become inspissated, wrinkled and shrunken, or flat, or yellowish. It may glisten with scattered cretaceous deposits and bright crystalline accumulations. The upper portion of the lens may become quite clear and some vision

may be regained at this stage. However, the degenerative changes spread to the zonule. Such lenses dislocate spontaneously with great frequency or may dislocate readily during operative procedures for their removal. Therefore, a hypermature cataract should be extracted if possible before it reaches a shrunken state. I believe in extraction whenever the cataract is definitely hypermature, despite normal vision in the other eye.

The glaucoma syndrome is inspired by mechanical trauma to the ciliary body and iris root by movement of the loose nucleus lying within the capsule, producing a reflex vascular disturbance throughout the eye; or, it may be initiated by a toxic effect. Spontaneous absorption of the lens cortex, according to Buffington, results in the formation of amino acids or peptides. These may diffuse through the intact lens capsule, causing an irritation of the neurovascular mechanism with round-cell blockage of the interstices of the corneoscleral trabeculas, with a resultant increased tension. The eye becomes inflamed and painful and one has no choice but to operate in an acute crisis. However, extraction of the lens causes immediate resolution of the symptoms, and changes apparent in such a highly inflamed eye are often dramatic.

In the shrunken cataracts, the capsule forceps will usually grasp the capsule and bring the lens forth intact. If the capsule ruptures, removal of the nucleus and complete irrigation of the capsular contents will bring about a happy result. The capsule may then be fished out entirely with other forceps. But if the capsule is tight and slick and does not allow grasping with the blunt capsule forceps, a Smith-Indian or erisophake extraction is preferable.

One is always hesitant to do an intraocular procedure on an acutely inflamed eye. Some such hypermature cataracts will cause inflammatory symptoms due to dehiscence of the lens capsule or actual rupture of the capsule. One may see such eyes before glaucoma complicates matters, and removal of the lens should be done at once. If glaucoma is present and the pressure is under 40 mm. Hg (Schiøtz), I do not hesitate to do a combined extraction. As a matter of fact, I have seen some eyes lost to malignant glaucoma, which might have been salvaged if the surgeon had been less timid. Some such eyes have an exudate in the anterior chamber resembling hypopyon. It is amazing how such eyes clear with removal of the hypermature cataract.

Glaucoma capsulare

Sobhy Bey, in his monograph on this subject, credits Vogt with the discovery of this syndrome by his work in biomicroscopy. He described an exfoliation of the lens capsule in a peripheral ring, complete or sector only, associated with a central or pupillary area change distinguished by a homogenous haziness or very faint opacity. Simultaneously with these changes were observed blue fluffy masses on the iris border, iris stroma, or posterior corneal surface which were interpreted as masses of exfoliated lens capsule cast into the aqueous.

Trantas states that the capsular lesions are part of a senile degenerative change which attacks all the ocular tissues, especially the glass membranes, and that a similar alteration in the drainage channels explains the tendency toward glaucoma. Deposition of the cast-off pellicles in the already-degenerated pectinate ligament and Schlemm's canal definitely adds fuel to the fire. This is accompanied by dissemination of the uveal pigment, which is deposited on the pectinate ligament in the chamber angle and can be easily recognized by gonioscopy. Sugar states that a characteristic trabecular pigment ring overlying Schlemm's canal is always present.

Since observers state that 33 to 70 percent of eyes exhibiting these changes develop increased tension, the syndrome is one of great importance.

Removal of the cataractous lenses in cases

of glaucoma capsulare has no great effect on the ocular hypertension. Sugar states that, in his series of 12 cases, all had ocular hypertension at least once postoperatively. However, the tension was controlled in 10 cases with miotics; two required cyclodialysis.

Subluxated lenses or cataracts

Some question may be raised as to the propriety of including this subject under the general heading of secondary glaucoma due to cataract, but the relationship of secondary glaucoma to subluxated lenses is an important one, and some such lenses are cataractous.

A dislocated lens, clear or cataractous, congenital or due to trauma, may remain in status quo without giving rise to symptoms of hypertension for years and is best left alone; definitely so if vision in the other eye is good. Trauma to the ciliary body may initiate an irritative iridocyclitis, secondary glaucoma may ensue, and treatment may exhaust every resource of the practitioner, with absolute glaucoma as the result.

Partial dislocations, if backward, give rise to no hypertensive symptoms. This is the common finding in arachnodactyly or in congenital dislocations without general anatomic anomalies. Occasionally, the vision can be improved with dilatation of the pupil with weak atropine solutions and the use of an aphakic correction, but my experience has been that patients prefer the myopic correction of the peripheral portion of the lens or no correction at all.

If the dislocations are forward, they cause a mechanical obstruction of the filtration angle by pressure of the lens on the ciliary body, by peripheral anterior synechias formed as a result of the irritation, or by the presence of the entire lens in the anterior chamber. The latter has been personally observed as a result of trauma and in hypermature cataract, and the employment of rapid miotics trapped the lenses in this new location and allowed their removal by simple keratome incision. Another case, in a child with arachnodactyly, was seen after this circumstance had occurred in a neighboring state, the correct procedure was visualized by the attending ophthalmologist, but the lens was not trapped by miotics, fell back into the vitreous before the child arrived in the office of the consultant, and complete retinal detachment and a lost eye was the result.

Partially dislocated lenses and cataracts with secondary glaucoma demand more than the accepted filtering operations for primary glaucoma. Removal of the lens becomes imperative. In younger individuals transfixion with two knife needles, a lens hook, or a diathermy needle, or grasping the edge with a cataract forceps may prove effective. Considerable vitreous loss must be anticipated but may occasionally be surprisingly minimum.

In older persons in whom the vitreous is more fluid, a dislocated lens may frequently be lifted out with a lens loop with little damage to the intraocular structures. Or a broad, flat spatula may be inserted against the posterior surface of the lens and, by mild counter-pressure externally, the lens may be made to slide up the spatula. A wide, broad-based iridectomy facilitates removal and may have some effect in reducing tension.

In treatment prior to surgery, one must remember that miotics seldom influence for the better a secondary glaucoma of this type and may actually increase tension, and that wide dilatation of the pupil with neosynephrin (10-percent solution) or immobilization of the iris and ciliary body with atropine may relieve a crisis.

In complete dislocations backward into the vitreous, the patient should be placed in a prone position for 24 to 48 hours if necessary, maintaining wide mydriasis, in the hope that the lens will come forward into the anterior chamber or in a position where it can be handled with instruments. If the lens lies inferiorly in the vitreous, it can be looped out by direct observation. I have not found the ultraviolet light of any service whatsoever in this situation. If the

lens lies directly backward against the retina on the posterior pole, if it is not altered by the prone position, and if the glaucoma remains intractable, there remains no alternative than to attempt removal by transfixion with the lens hook under direct ophthalmoscopy. The treatment of subluxated lenses or cataracts with secondary glaucoma is always difficult and the glaucoma frequently becomes malignant.

In cataracts with secondary glaucoma, the lens may not move forward because of the constant high intraocular pressure, in which extreme paracentesis or cyclodialysis should be done to effect temporary reduction in pressure and allow the lens to shift forward toward or into the anterior chamber. The management of this condition may be totally unsatisfactory and many of these eyes come to enucleation.

130 Madison Avenue (3).

Symposium on Secondary Glaucoma

GLAUCOMA SECONDARY TO UVEITIS*

WILLIAM B. CLARK, M.D.
New Orleans, Louisiana

In a recent brilliant summary of the evidence presently available in favor of a vascular origin of glaucoma, Dienstbier, Balik and Kafka[1] concluded their discussion with the following statement:

"Our conception of glaucoma has therefore changed very much during the last few years. Two fundamental things are necessary: a careful diagnosis of glaucoma and the revision of our treatment. These are the problems with which we must concern ourselves."

It would be hard to find a better introduction to a discussion of glaucoma secondary to uveitis than these words provide. From every standpoint—etiology, diagnosis, and therapy—secondary glaucoma is a highly controversial subject. Moreover, presentations dealing with it in both the textbook and the periodical literature are generally misleading. I am not alone in my opinion that it is unfortunate that secondary glaucoma should be universally discussed under the general heading of glaucoma, as if it were a disease analogous to primary glaucoma. Actually, the two diseases have little in common beyond the fact that in both the intraocular pressure is elevated, and that in both the function of the eye may be irretrievably damaged or completely destroyed, even when treatment is prompt and proper.

Duke-Elder[2] well defines secondary glaucoma as a group of loosely knit and unrelated clinical cases whose only common denominator is the fact that some recognized pathologic lesion is complicated by an increase in the intraocular pressure, with attendant symptoms.

It is impossible to discuss the concept and therapy of glaucoma secondary to uveitis, even before an audience possessed of the knowledge and experience of this audience, without emphasizing certain elementary but essential considerations. I regret the necessity but I cannot avoid it.

ETIOLOGY OF SECONDARY GLAUCOMA

For well over half a century the belief was generally held that glaucoma secondary to an inflammatory condition such as uveitis arises from an obstruction to the circulation of the intraocular fluids, sometimes at the pupil but more frequently at the drainage angle, by debris thrown out into the aqueous and lodging at these points, much as leaves

* From the Department of Ophthalmology, Tulane University of Louisiana School of Medicine.

would block a drain. This is a convenient theory but it is neither conclusive nor entirely inclusive.

Within the last two decades a number of ophthalmologists, of whom Duke-Elder has been the leader, have taken the position that a glaucomatous condition which is not subsequent to inflammation or is not the result of lenticular change is secondary to vascular disease and is the result of a disturbance of the intraocular circulation. On this vascular background the obstructive factor just described is frequently but by no means always superimposed.

I cannot do better than to quote, in essence, Duke-Elder's[2] exposition of this still relatively new theory. The vascular disturbance, he notes, is the development of a state of congestion, stasis, and ultimate edema of the tissues brought about (1) by actual obstruction of the veins draining the uveal tract, or (2) by a dilatation and increased permeability of the capillary-venous system induced by vasomotor reflexes. This effect, he continues, is spread throughout the uveal tract through the mediation of axons reflexes and is frequently initiated, as his own work suggests, by the liberation in situ of histaminelike substances.

The result of what Duke-Elder calls this "vascular 'flare'" is three-fold: (1) The development of a high capillary pressure, (2) the formation of a colloid-rich plasmoid aqueous, and (3) the entire disorientation of the normal dialysation of intraocular fluid. If the drainage channels are patent, the rise of tension may be partially or largely compensated for. If they are not, as they frequently are not, and if their safety-valve mechanism is rendered ineffective by pathologic alterations, then secondary glaucoma develops much more readily. Under these circumstances the rise in tension is abrupt. When the drainage channels are completely obliterated, as they are in congenital deformities or essential atrophy of the iris, the pathologic rise of tension is likely to occur gradually and insidiously.

If this new theory is correct, as increasing experience has convinced many of us that it is, then the ophthalmologist, when he sees a patient with uveitis and elevated intraocular pressure, can no longer be as certain of the chain of events as he once was. The sequence may not be uveitis-glaucoma at all. It may quite conceivably be the superimposition of uveitis on a vascular, preglaucomatous background. Unless the patient with uveitis associated with glaucoma has already been well studied, it is impossible to be certain that one is not dealing with an eye already the subject of vascular alterations which have been precipitated, so to speak, from latency into clinical activity because, for one reason or another, a uveitis has developed.

The circulatory system, although somewhat incompetent previously, may have been adequate enough for all purposes, just as the liver, in the so-called liver weakling who dies a postoperative liver death, may have been adequate enough for the ordinary strain of life. But the intraocular circulatory system, subjected to the strain of uveitis, may not have been able to tolerate it, any more than the damaged liver has been able to tolerate the strain of anesthesia and surgery. There may, however, have been no previous evidence of vascular abnormality, even if the patient has been under observation, because it is well known that a patient with secondary glaucoma can withstand a prolonged increase of intraocular pressure that is insidious and gradual without atrophy of the papilla much better than he could withstand the abrupt alterations of primary glaucoma.

One other possible complicating factor must also be taken into account in glaucoma secondary to uveitis, the established fact that certain eyes are anatomically predisposed to glaucoma. Whenever the anterior chamber is shallower than normal, the anterior surface of the iris lies nearer than normal to the posterior surface of the cornea. As a result, the acuity of the angle

of the anterior chamber is increased and the size of the outlet of the aqueous humor is decreased. As a further result, when conditions which produce blockage are present, obstruction occurs much more rapidly than it does in the normal eye.

Therapy of secondary glaucoma

How, then, do these changing concepts influence the therapy of glaucoma secondary to uveitis? They influence it very decidedly. But first let us settle the question of the basic treatment of uveitis, which depends, of course, upon the causes which gave rise to it.[6] This is not the time to go into the question of diagnosis, except to point out that the number of cases of idiopathic disease will always be in proportion to the amount of care expended in seeking the cause of the condition. There are methods available to determine whether the etiologic condition is syphilis, tuberculosis, or brucellosis, or foci of infection in the teeth, sinuses, tonsils, or elswhere in the body, or some other cause.

Whichever of these causes is identified as the possible etiologic factor, it must be treated actively, by acceptable methods. In addition, general measures must be employed to improve the patient's general health and to raise his level of resistance. Antibiotics may be tried in appropriate cases; they will be ineffective in those cases in which they are not indicated. Foreign-protein therapy, in the form of milk or typhoid vaccine, or artificial fever therapy by diathermy or other methods, all have their place, though whether such results as are achieved are specific or nonspecific it is hard to say. It is quite possible that results achieved with foreign-protein therapy are the result of mild protein shock rather than of a specific reaction. Vaccine therapy, Duke-Elder[2] shrewdly notes, introduces the widest divergencies of opinion and is probably associated with an equally wide variety of results. The theory behind the method is sound but until we know a great deal more about it than we now know, it must remain a trial-and-error method, with the greater emphasis, I fear, on the error.

So far the therapy of uveitis with increased intraocular pressure is on fairly safe ground. It is when we come to purely local measures that difficulties begin to arise. Subconjunctival injections of various kinds, as Woods[3] remarks, "have now, quite happily, fallen into disuse." Local measures which are generally employed are measures to relieve pain—the application of heat, and the instillation of mydriatics, with surgery as a last resort if these methods are not effective.

There can be no quarrel with the relief of pain by any acceptable means. The local application of heat, while it may increase congestion and hypertension, also produces venous dilatation and promotes absorption, and as a rule its benefits far outweigh its disadvantages. The instillation of mydriatics is also indicated in simple uveitis, when there is no rise in intracoular pressure or only a minimal rise. Then both the inflammatory and the hypertensive state must be combated and the ophthalmologist frequently finds himself on the horns of a dilemma.

The initial increase in hypertension, which develops during the active stages of an iridocyclitis, is likely to disappear promptly if the patient is seen early and if the inflammatory disease is diagnosed promptly, if its etiology is identified, and if it is properly treated. If, however, the intraocular pressure develops later, as the result of structural changes, then the ophthalmologist who accepts the theory that secondary glaucoma arises on a vascular background may indeed be in a difficult position. Shall mydriatics be used to control the uveitis? It is obviously important that dilatation of the pupil be accomplished early and adequately. The earlier it is accomplished, the less is the chance of permanent damage to vision and the less the risk of the formation of synechias. But if the new theory of secondary glaucoma is accepted, then the use of mydriatics is a very bad thing indeed. By increasing the already elevated intraocular pres-

sure these agents may give rise to such serious complications that the good results they might achieve in the treatment of uveitis are completely overshadowed.

On the surface, the solution of the problem seems simple, to ignore the uveitis, at least locally, while miotics are employed to lower the elevated tension. But again the situation is not so simple. Miotics tend to influence uveitis unfavorably. They produce irritation of the musculature of the ciliary body and the iris, they increase congestion, they cause increased formation of exudates, and they favor the production of adhesions. Yet, if tension continues to increase, or does not decrease, they seem strongly indicated, especially in the so-called preglaucomatous patient, and especially if that type of patient has a shallow anterior chamber.

I am afraid I cannot offer any very satisfactory solution for this difficult problem. My own practice, like that of Duke-Elder,[2] is to treat each patient on an individual basis, though that, as he remarks, is not easy either, since glaucoma secondary to uveitis is a combination of conditions in which the picture changes from day to day. When the uveitis is acute and the anterior chamber is deep, Duke-Elder's practice is to employ atropinization because it is urgent to establish dilatation of the pupil with resulting decongestion of the anterior segment and the breaking down of existing synechias. I cannot altogether share his optimism that, if these results are achieved, reduction of hypertension usually follows, though I am quite prepared to agree that the massive dosages of atropine required to achieve the desired results frequently require courage on the part of the ophthalmologist. If the increased intraocular pressure seems more important than the uveal inflammation, then miotics must be used, with great caution, of course, because of their possibly adverse effect on the uveitis. Adrenergic drugs are best, my own preference being for 10-percent neosynephrin.

In glaucoma secondary to uveitis, as well as in uncomplicated uveitis, surgery must be resorted to without undue delay if the nonsurgical measures outlined do not produce prompt results. Paracentesis is the first resort in both conditions, though there is still no general agreement whether its effect is hyperemic, or is achieved by flooding the chambers of the eye with a plasmoid aqueous rich in immune bodies, or is entirely mechanical. Iridectomy has also been recommended for the treatment of uveitis and is indicated without delay if iris bombé develops. Otherwise, it is a dangerous procedure unless it is performed in carefully selected cases and at a carefully selected time, that is, during a quiet interval, when the inflammation in the uveal tract is apparently quiescent.

If paracentesis is not promptly effective in glaucoma secondary to uveitis, there should be no great delay in resorting to more radical measures. Duke-Elder[2] advises posterior sclerotomy. Others advise basal iridectomy. My own preference is for iridectomy combined with a filtration procedure, the modified Lagrange operation being, in my opinion, the best of the available methods.

Summary and Conclusions

The management of glaucoma secondary to uveitis is at this time both unsettled and unsatisfactory. It is not clear in all cases that the sequence of events is uveitis followed by glaucoma. If the vascular etiology of glaucoma is accepted, it is quite possible that the sequence is the superimposition of uveitis on a background of what might be termed latent glaucoma, which itself arises on a vascular basis. The use of mydriatics is indicated for the control of the uveal inflammation but may gravely increase the intraocular pressure. The use of miotics is indicated to reduce the intraocular pressure but may influence the uveitis adversely.

The best that the ophthalmologist can do, with the methods presently available, is to treat each patient on an individual basis, to employ mydriatics or miotics according to

the condition predominant in the special case, and to resort to surgery without undue delay if the uveitis is not controlled or if the intraocular pressure is not reduced or if it continues to increase.

Paracentesis is the first surgical measure, no matter which condition dominates the picture. If it does not achieve results, iridectomy may be employed in carefully selected cases in which uveitis seems the more important, while iridectomy combined with a filtration procedure (preferably the modified Lagrange operation) gives the best results in cases in which the glaucomatous disease predominates.

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Symposium on Secondary Glaucoma

GLAUCOMA SECONDARY TO TRAUMA

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When an eyeball becomes hard following an injury, the condition is usually spoken of as secondary glaucoma, although, strictly speaking, since it does not follow the usual course of a primary idiopathic glaucoma, it probably should be referred to as secondary hypertension. But for the sake of convenience we shall continue to call it traumatic glaucoma.

In the majority of cases following injury, there is some visible intraocular damage which seems to offer a reasonable explanation for the secondary glaucoma. In many other cases, however, there is no visible damage and the reason for the increased tension is more obscure. Simple contusion of the eyeball is one of these.

The greatest single feature of this type of injury is not so much the hypertension which follows, but the *instability of the tension.* In animal experiments, the contusion is usually followed quickly by a short period of increased tension, which soon gives way to a longer period of hypotony. There is probably a similar reaction in man but many irregularities occur so that a similar tension curve cannot be drawn. Usually the eye recovers without any serious effect, but there may be a persistent hypertension or hypotony.

The hypotheses to explain this type of glaucoma are interesting: (1) Edema of the uvea because of blockage of the lymphatic channels with loose cells; (2) increased protein content of the aqueous blocking the angle; (3) sympathetic irritation causing hypersecretion; (4) thrombosis of ciliary blood vessel; (5) tearing of ciliary muscle; (6) intraocular hemorrhages; (7) orbital hematoma obstructing venous outflow; (8) dislocation of the lens.

Although secondary glaucoma may follow any one of these conditions, some of them are never present; furthermore the result may be hypotony instead of hypertension.

It seems more reasonable, therefore, to assume the primary mechanism to be an upset of the local nervous control of the circulation, any disturbance of which is generalized over the entire uveal tract by axon

reflexes. Traumatic glaucoma of this type thus seems to be based on a local neurovascular reaction.

This would explain (a) the neural damage which is often seen histologically, (b) the behavior of the injured eye and its fellow in clinical and experimental trauma, (c) the lessened reaction in deep anesthesia in animals.

The prognosis and treatment naturally depend upon the severity of the associated lesions. While the majority of these eyes terminate favorably, some go on to enucleation because of prolonged tension and severe pain. The mild cases do well with simple rest and a protective bandage, but others require medication or operation or both.

Miotics seem to give better results than mydriatics but it is sometimes helpful to alternate the two. Other eyes do well with instillations or subconjunctival injections of adrenalin.

When medication fails, simple paracentesis may be sufficient to control the tension, otherwise iridectomy or other antiglaucoma operations are necessary. It is interesting to note that an eye with secondary glaucoma can tolerate a relatively higher tension than an eye with primary glaucoma without any residual damage. It is often advisable therefore not to consider operation until all other means of relieving the tension have been thoroughly tried.

In contradistinction to the immediate effect of direct trauma, there is a posttraumatic glaucoma in which the onset of tension is delayed a considerable time. It is usually due to a penetrating injury or rupture of the globe, often with the incarceration of some intraocular tissue in the wound.

Obliteration of the filtration angle must be considered partly responsible for the increase in tension in these cases but, in addition, disturbances of the neurovascular reflexes by irritation of the iris and ciliary body must not be overlooked.

The retention of an inert foreign body, for example, may continue for a considerable time before secondary glaucoma supervenes, thus disproving a purely mechanical cause.

The onset of secondary glaucoma following a penetrating wound depends upon many factors. The iris root is often pushed forward by the sudden evacuation of aqueous and, if it is permitted to remain in direct contact with the cornea, filtration will be blocked. Simple closure of the wound by pressure dressing, or sutures if necessary, often suffices to allow reformation of the anterior chamber without further trouble. But continued apposition of iris and cornea produces peripheral anterior synechias and, if these are extensive enough, necessitates an antiglaucoma operation.

When iris tissue is incarcerated in the wound, a different problem presents itself. Tension almost invariably follows unless the pupillary margin is free to permit communication between the anterior and posterior chambers. If the iris cannot be freed from the wound, iridectomy is necessary.

In addition there is always the possibility of delayed glaucoma as the result of continued irritation or late infection. When a low-grade iritis supervenes, the situation becomes more difficult. Atropine and salicylates are often helpful but it may be necessary to alternate mydriatics and miotics. Paracentesis may be required.

In the presence of uveitis neither miotics nor mydriatics are effective when the pupil is bound down. Paracentesis with puncture of the bulging iris may suffice to lower the tension but complete iridectomy is often the only operative solution.

Flat scars on the globe without incarceration of the iris often produce no tension, but there is always the possibility of undetected intraocular disturbances which give a delayed reaction.

Keratectasia is usually the result instead of the cause of tension.

The lens presents many problems following trauma. The glaucoma which follows its subluxation is probably initiated by ir-

ritative action on the ciliary process and even glaucoma following complete dislocation is more than mechanical in origin. Repeated gonioscopic examinations have shown that the angle is not blocked and that very few synechias are present.

When a dislocated lens is clear and lies behind the iris, the tension may often be controlled by miotics. If operation becomes necessary, cyclodialysis seems a safe and logical procedure. Paracentesis is contraindicated in these cases for fear of allowing the lens to come forward, but, if it is only subluxated, paracentesis may be attempted. When the lens lies in the anterior chamber, extraction is almost imperative, whether the lens be cataractous or not.

A swollen cataractous lens should be removed regardless of its location and, if the capsule has ruptured, the anterior chamber must be carefully irrigated to prevent blocking of the angle by soft lens matter and capsular tags.

Sudden swelling of the lens after injury almost invariably produces increased tension, especially in elderly people in whom the sclera is rigid. It appears gonioscopically like acute glaucoma, with narrowing of the angle or actual blocking by the iris root. Antiglaucoma operations may succeed if the anterior chamber is not too shallow and the tension not too great, but the lens usually has to be extracted in order to open the angle and to remove its irritative effect.

In aphakic eyes with round pupils, the vitreous may herniate forward to fill the pupil and block the communication between the anterior and posterior chambers. If this is not relieved by mydriasis, or if an injection of air into the anterior chamber does not push the vitreous back, a complete iridectomy may relieve the condition. Following minor injuries the vitreous often recedes spontaneously.

When vitreous enters the anterior chamber, it can cause an increased tension by blocking the angle; or it may set up an irritative process that results in glaucoma. Epithelial cysts following injury or operation probably behave in the same manner.

Hemorrhage in any part of the eye may cause a temporary glaucoma by increasing the intraocular contents by its mere space-filling property. Posterior hemorrhage pushes the iris forward, permitting adhesions to the cornea. Anterior hemorrhage may block the angle. Spontaneous absorption which is sometimes aided by pressure bandage, relieves the situation. Evacuation of the blood is often possible in the anterior part of the eye, but it is not so successful in the posterior part.

Secondary glaucoma from sympathetic ophthalmia is usually due to a plastic exudate. It is especially desirable not to operate these cases for fear of starting up a reaction. Hypertonic solutions and atropine are suggested.

Secondary glaucoma due to other forms of trauma such as chemical, thermal, and photo-electric, is not as common as that due to mechanical injuries. It must be borne in mind, however, that any type of trauma, including burns and corrosive injuries near the limbus, may set up an attack of glaucoma.

Secondary glaucoma following operative trauma is an interesting phase of this subject and can be considered in great detail. But the results and reactions are in general the same as those found in posttraumatic glaucoma following penetrating injuries, and the management is along the same lines.

The treatment of posttraumatic glaucoma is usually surgical and must be aimed at relieving the irritation. Operations for the relief of tension alone will not be successful, for the eye will continue to get worse even when the tension is brought down. A necessary preliminary to operation is a thorough understanding of the condition present, and when possible, its cause.

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Symposium on Secondary Glaucoma

THE CONGENITAL OR INFANTILE GLAUCOMAS

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The term "congenital glaucoma" is used to indicate a state of raised intraocular pressure due to an intrauterine disturbance and manifest during the first few years of life when increased intraocular pressure is associated with ocular distention. The term is not inclusive of certain types of secondary glaucoma in infants so the designation "infantile glaucoma" might better be used.

As in adult glaucoma, congenital infantile glaucoma may be primary or secondary. The primary congenital infantile glaucomas are those which do not follow other ocular disease and comprise those due to developmental anomalies. The secondary congenital or infantile glaucomas follow other recognizable ocular disease.

Classification and Incidence

The following classification of the congenital or infantile glaucomas is presented:

A. Primary congenital or infantile glaucomas
   1. Hydrophthalmia
   2. Congential or infantile glaucoma associated with developmental anomalies
      a. Congenital or infantile glaucoma associated wtih aniridia
      b. Congenital or infantile glaucoma associated with neurofibromatosis
      c. Congenital or infantile glaucoma associated with microcornea

B. Secondary congenital or infantile glaucomas
   1. Secondary buphthalmia—following corneal perforation with inclusion of iris in reparative scar
   2. Secondary glaucoma associated with choroidal angiomatosis
   3. Secondary glaucoma associated with retinoblastoma
   4. Secondary glaucoma associated with retrolental fibroplasia

The term congenital glaucoma is usually used in reference to hydrophthalmia, but, as shown above, the other conditions must be classified under that heading. The term buphthalmia is often used synonymously for hydrophthalmia.

Hydrophthalmia is not a common condition. In the available statistics from various eye clinics the incidence varies from 0.03 to 0.079 percent.[1] Lehrfeld and Reber[2] reported an incidence of 0.011 percent among 250,000 patients. In 1925 from 5 to 13 percent of blind-school inmates had hydrophthalmia (Gonin,[3] Lamb[4]). Approximately two thirds are males and two thirds (70 to 74 percent) are bilateral. One eye may not be affected for some time after birth or it may be affected very soon thereafter.

Gros[5] reported that, of 45 cases of hydrophthalmia, 60 percent were present at or assumed after birth, 13.3 percent were first noted during the first year, 17.7 percent between the first and third years, and 8.8 percent later.

Heredity plays an important role in this condition and is apparently recessive even though several children of a family may be affected. Hydrophthalmia will not develop unless two conductors of the disease marry. One fourth of their children are affected and these plus two thirds of the apparently normal members of the family become potential conductors. Consanguinity is of little or no importance.

The importance of maternal rubella as the cause of hydrophthalmia cannot yet be evaluated. Guerry[6] reported two cases fol-

lowing maternal rubella during the first and second months of pregnancy.

Development of chamber angle

In order to understand the anatomic background for one of the surgical methods of the treatment of hydrophthalmia, it is necessary to review briefly the development of the chamber angle. The portion of the eye which is to form the anterior chamber is filled with a mesodermal meshwork from the 16-mm. stage on. At about the end of the fifth month the anterior chamber begins to form. At the beginning of the seventh month the anterior chamber is still very shallow.

As time goes on the mesoderm disappears except for those portions which form the iris stroma, the trabeculum and the rudimentary pectinate ligament. At birth, the angle is relatively shallow and does not reach its full development until between the ages of two to four years.

In hydrophthalmia, the cause of the glaucoma is attributed to a congenital defect of the chamber angle. In nearly all such eyes there is a persistence of an abnormally great amount of the mesodermal meshwork.

Gonioscopy reveals that the anterior layer of the iris has its insertion in the region of the end of Descemet's membrane, instead of the usual formation of a circumferential sinus with the iris inserting into the ciliary body. The stroma of this iris tissue is semitransparent so one may see the reflection of the pigment epithelium,[7] from the ciliary body to the iris, leaving a peripheral thin zone of iris tissue with no pigment epithelium posteriorly.

Pathologic anatomy in hydrophthalmia

Distention of the globe with enlargement of the corneal diameters is the most obvious evidence of hydrophthalmia. However, an increase in the size of the orbit proceeds in relation to the size of the globe.

The largest recorded globe in hydrophthalmia measured 44 mm. by 30 mm. (Coronet and Aurand[8]). The average dimensions of 17 specimens measured by Anderson[1] showed that the anteroposterior diameter increased 5.6 mm., the horizontal diameter 3.2 mm., and the vertical diameter 2.5 mm. The corneal diameter was increased much greater in proportion to the dimensions of the globe.

The conjunctival vessels may become greatly dilated as the hydrophthalmic process continues. The sclera becomes thinned and may become quite ectatic near the limbus and gives a bluish-white appearance to the sclera. The thinning near the limbus leads to forward displacement and increased diameter of the cornea. The corneal surface is flattened. The posterior scleral thickness appears generally to be within normal limits but, according to Anderson, there is probably a compensatory scleral hypertrophy in those eyes with a mild or early degree of hydrophthalmia but thinning in advanced cases.

Opacification of the cornea is present in over 75 percent of all cases of hydrophthalmia. Most of these are due to ruptures in the endotheilum together with Descemet's membrane. Some are superficial and due to trauma and ulceration. The diminished corneal sensation is probably largely responsible for these.

As the endothelium heals over the curled edges of the tears in Descemet's membrane, a new Descemet's layer is formed. The edges of the Descemet's tears always remain visible. Some subepithelial colloid deposition may be found as a cause of permanent opacity in the areas overlying the tears.

Most ruptures of the endothelium and Descemet's membrane are present at birth. Their frequency varies directly with the degree of distention of the globe.

Adhesions between iris and central corneal defects have been found in hydrophthalmic eyes. These may be due to the presence of tears in Descemet's membrane and the endothelium long before birth.

The angle of the anterior chamber has been found to be open in slightly less than

50 percent of enucleated hydrophthalmic eyes (Reis,[9] and Schmidt-Rimpler[10]). In addition to the presence of peripheral anterior synechias, the following have been found:

1. Persistent or aberrant meshwork in the angle. Anderson[1] found this in at least 14 or 27 early specimens. This is the same condition which is shown gonioscopically.

2. Absent or poorly developed Schlemm's canal. Reis[9] and Seefelder[12] were the first to point this out. In addition, posterior (fetal) displacement of Schlemm's canal, as well as rudimentary development of the scleral spur, has been noted. Anderson found the canal of Schlemm to be absent or obliterated in 79.5 percent of cases.

In evaluating all findings of anatomic material in hydrophthalmic eyes, one must remember that even in the youngest material, the eyes are removed usually only after surgical procedures or severe painful inflammation and that findings such as peripheral anterior synechias and absence or obliteration of Schlemm's canal do not necessarily indicate that this is congenital. I am rather of the opinion that these are secondary changes.

The uveal tract shows degenerative changes in most cases, secondary to pressure usually. In early cases the uveal tissue is quite normal.

The crystalline lens is greatly affected by stretching of the zonule fibers. This may permit iridodonesis and possible dislocation of the lens.

The retina and optic-nerve changes are those due to prolonged pressure. The ganglion cells disappear. Connective tissue forms on the inner retinal surface. Sclerosis of the retinal vessels and detachment of the retina may be found. Cupping of the optic disc is found in the advanced stages of hydrophthalmia but the disc may be normal in appearance early.

Aside from the inferences resulting from these observations, the actual cause of hydrophthalmia is uncertain. It probably is the result of more than a single type of anomaly of the chamber-angle mechanism.

The *clinical picture* of hydrophthalmia is rather characteristic. It is recognized at birth or shortly thereafter by the enlargement of the eyeball and corneal edema. The cornea may reach a diameter of 17 mm. as compared to the normal of about 12 mm. The eyes are usually photophobic. The anterior chambers are deep.

Due to corneal stretching, tears of Descemet's membrane occur and cause local opacities in the cornea, since, with the tears in Descemet's, there are tears of the endothelium which is the corneal water-barrier. The tears are usually horizontal in the more central areas where most of them occur and concentric with the limbus peripherally. The horizontal tendency is probably due to flattening of the vertical meridian of the cornea.

The haziness of the cornea, other than in the localized areas, is usually due to epithelial edema and disappears on surgical incision into the globe. The enlargement of the eye is due to the distensibility of the infantile tissue. Cupping of the optic disc does not occur early due to the distensibility of the globe.

One would expect myopia to be present as a result of stretching of the globe. However, it is not always the case because of flattening of the lens and retrodisplacement of the lens which compensates for the axial lengthening of the globe.

The tension may be normal, even with obvious hydrophthalmia. This may be partly due to the fact that the cornea is much flatter than in adult eyes and the tonometer base plate does not fit well, and partly to the low ocular rigidity. Tonometry is difficult in infants and requires general anesthesia usually. Even here it may be difficult to get the tonometer perpendicular to the cornea unless anesthesia is fairly deep.

The differential diagnosis of hydrophthalmia includes megalophthalmia, megalo-

cornea, keratoglobus, and anterior staphyloma. Megalocornea has been considered to be arrested hydrophthalmia but is now considered a separate hereditary entity in which tears of Descemet's membrane do not occur.

Treatment

The treatment of hydrophthalmia has never been quite satisfactory. Medical treatment with miotics probably serves to lower the intraocular pressure to a certain extent before surgery but the difficulty, and the inaccuracy, of tonometry in young children makes this treatment uncertain.

Surgery is resorted to but, for the most part, helps only a minority of cases. The best surgical results are obtained during the first year, before the atrophic changes and distention have made much change in the tissues. Of the operated cases, reports[1] indicate that less than 10 percent have retained vision of 20/40 after two years. When operated and unoperated cases are compared, those patients who have been operated are somewhat better off. Twenty-five percent of operated cases are blind by the age of 12 years as compared to 54 percent of unoperated ones. By the ages of 25 years, 45 percent of operated and 60 percent of unoperated cases are blind.

The surgical procedures used in hydrophthalmia differ somewhat from those of adult glaucoma where the trephination, iridencleisis, cyclodialysis, and iridectomy are used. In hydrophthalmia, trephination, iridencleisis, cyclodialysis, and the goniotomy of Barkan[13] are used. Palomar Palomar[14] advises the use of Vogt's cyclodiathermy, especially in advanced cases.

The reason trephination may fail is the presence of the mesodermal remnants in the angle, which tend to block the opening, as well as the danger of late infection in individuals with a long life expectancy.

It is the mesodermal tissue which also makes more difficult the successful performance of cyclodialysis. O'Brien and Weih[11] recently advocated the cyclodialysis procedure in this condition.

The goniotomy operation was first introduced for adult glaucoma. In 1939, I did a series of nine goniotomies and concluded[15] from a prolonged period of observation that the operation did not permanently reduce the intraocular pressure. Since then, Barkan has discontinued the operation in adults but his reports[16] on hydrophthalmia indicate that the results have been excellent.

The theoretical rationale of the procedure is to incise the mesodermal tissue and expose the trabecular spaces in one fourth to one third of the angle circumference to gain access to the aqueous. Actually this has not been proven, though the reported results are remarkable. The possibility that the vasodilating effect of irritation of the iris as in the Curran operation may be a factor has not been considered. It may even be possible that the operative procedure may result in spontaneous arrest of the hydrophthalmic process, as a result of changes effected on the vascular reflexes.

It appears that one of the most important considerations in evaluating the surgical treatment of hydrophthalmia is how early operation is done. In those operated upon below the age of one year the prognosis is much better than otherwise. If operated upon when advanced, there is great danger of collapse of the globe. Barkan's procedure is then not expected to be effective.

The first operation in which incision of the angle of the anterior chamber was done in treating congenital glaucoma was reported by Tailor[17] (1891-1892) and de Vincentiis,[18] in 1893. The operation was then rarely used except by some Italian and French oculists until Barkan reported his results on 17 eyes in 1942. In only one of these did the operation fail to normalize the ocular tension.

In 1947 Barkan[13] added the report of the results in 76 eyes with congenital glaucoma, in 66 of which the tension was normalized and the vision maintained. His follow-up

period varied from six months to 10 years. Repeated goniotomy was required in 22 eyes before the tension was normalized. The operation was performed under the goniotomy contact lens in 20 eyes, all of them successful.

Barkan considered the results of goniotomy successful when the ocular tension never rose higher than 35 mm. of mercury with the McLean tonometer or 21 mm. Hg with the Schiøtz tonometer, three months after operation, no miotics having been used during the two weeks preceding measurement of the pressure.

Barkan has concluded that the goniotomy or goniotrabeculotomy operation gives excellent results in early cases, before distention of the globe is marked. He states that it is indicated in all cases in which the characteristic gonioscopic picture is present but in which marked distention and degeneration of the globe have not taken place. The advantages of the procedure are the absence of disfigurement of the iris and ease of repetition when necessary. The dangers of the operation are excessive hemorrhage and the possibility of iridodialysis, injury to the ciliary body, and injury to the lens.

The operation is best done under direct observation, under a goniotomy contact lens. In cases in which corneal clouding precludes this, the operation can be done without it.

Scheie[19] reported normalization of tension in 11 of 16 eyes in patients under one year of age with congenital glaucoma. He did the operation without the aid of a goniotomy lens. The follow-up period of observation in his series was one and one-half years or longer. Air injection according to the method of Chandler was found useful by Scheie.

I have performed iridencleisis on one eye and goniotomy on the fellow eye (the less advanced one) in five infants but feel that the results in my hands of both types of operation in hydrophthalmia do not warrant enthusiasm. If the goniotomy procedure acts by separating the mesodermal meshwork from the trabeculum, the cyclodialysis operation, performed in such a manner as to do this, such as by O'Brien's technique, should give results which are at least as good.

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THE MACULA IN THE ELDERLY*

The 12th de Schweinitz Lecture

Arthur J. Bedell, M.D.
Albany, New York

This memorial lecture is given in recognition of the services rendered humanity by George E. de Schweinitz, a man of unusual charm of person and speech, a renowned teacher of ophthalmology, and an author of outstanding skill in the presentation of well-correlated material.

As professor of ophthalmology in Jefferson Medical College and later head of the department of ophthalmology in the University of Pennsylvania, he won the admiration of the students for his remarkable memory, his keen perceptions, and logical dissertations, and their gratitude for the patience he displayed in their instruction.

Dr. de Schweinitz was a statesman in the best sense of the term. He carried the message of improvement in the care of the sick to the medical profession and the laity. This skill culminated in his elevation in 1922 to the highest political office in American medicine, the presidency of the American Medical Association.

We who follow him are inspired by a review of his life. From his philosophy we may learn much: to help us confute the derogatory exaggerations and falsehoods of those who would make medicine a state function. Under such control it would be impossible for any physician to achieve more than mediocrity or aspire to the fulness of vision which was a characteristic of the scholarly George E. de Schweinitz. He rose to fame by consistent, continuous effort to perfect himself in all that pertained to the art and science of medicine.

It is a great privilege to address you in remembrance of the indefatigable George de Schweinitz.

The macula in the elderly

The medical problem of caring for the elderly has assumed a prominent position in discussions on the health of the people of this nation. Geriatrics is accepted as a specialty, but as yet there has been no concise, readily available, comprehensive description of the changes in the macular region in the old.

We are greatly indebted to the scores of authors who have recorded their findings, drawn conclusions, and added their names to the long list of eponyms. We also appreciate the comparatively few drawings and the still fewer photographs. Because of the limitations of time and space, no reference will be made to the articles which have been published and no disease names will be introduced.

As far as is known, there never has been any long series of photographs covering months or years of observation. It is evident to the clinician that this is the only available method by which the course of the fundus alterations can be followed and each new phase correctly placed in the all inclusive progression. It is especially true that, in many of the serious destructions, the disease advances without phases or stages; that it is a constant destructive or invasive process.

Even the most instructive monographs on the subject overstress certain major appearances without regarding them as a part of the whole inexorable transformation.

This address will illustrate changes found in the macula of the elderly by means of photographs, and attempt to reduce the number of so-called entities by showing that many

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are simply phases of macular diseases which pass through or terminate in somewhat similar but variable scars. The appearance of the fundus has led to a multiplicity of designations, a considerable amount of misunderstanding, and, to a certain extent, has retarded the recognition of the basic alterations of the comparatively few types of senile macular disease.

The time when a macular lesion presents symptoms depends upon a great many factors, the first of which is the acuteness of observation on the part of the patient. The ability to recognize early and trivial departures from normal brings the patient to the physician at an early date. But, unfortunately, it is not uncommon to find unobservant patients practically blind in one eye before they appreciate the interference with their vision.

When first seen, the fundus appearance does not always reflect the original phase of onset and for that, and other reasons, all types must be understood and the changes recognized and correlated.

A study of hundreds of fundus photographs has led to the definite clinical conclusion that there are demonstrable patterns, and that the life cycle of many can be recorded. This has resulted in the deletion of many name diseases which often were only isolated periods of progressing destructions.

The macular diseases will be segregated into three groups. These are not hard and

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PLATE I (BEDELL). 1. *Drusen*. H. F., a 55-year-old woman, with corrected vision of 20/15, had drusen in both eyes. Small, bright spots were widely distributed about both the disc and the macula on a pale fundus. These were beneath the retinal vessels.

2. *Drusen*. M. S., a man, aged 25 years, had a number of closely packed, brilliant, pale drusen about the macula. Vision was 20/20.

3. *Exudates*. E. P. was 46 years of age. Eight years before he had had a severe macular retinopathy with a high NPN. Vision of the right eye was 20/20. There were an immense number of small, pinpoint spots similar in appearance to drusen.

4. *Drusen*. S. K., a 66-year-old man, had innumerable, small bright spots in and about the four disc-diameter macular region. Vision with correction for mixed astigmatism was 20/20.

5. *Drusen, macular retinitis*. Mrs. M. C., aged 66 years, had many, large, flat, pale-gray deposits surrounding a pink macula with a fine, granular pigment border. Vision of the right eye, with correction, was 20/40. The peripheral field was contracted and there was a small, central scotoma.

6. *Retinochoroiditis*. A. B., aged 62 years, had poor sight in her right eye for four months. Vision was 4/200; with correction, 20/70. Very large, flat, yellowish-gray spots surrounded a depigmented macular area in which there were several, pale, smoky-gray deposits.

7. *Retinochoroiditis, drusen*. Mrs. M. L. The right eye of a woman, aged 63 years, showed many glistening plaques in and about the macula on a fine, granular, pigmented base in which the choroid was partly absent. The vision was 20/30.

8. *Drusen, choroiditis*. Mrs. L. S. was 63 years of age when, after 12 years of poor sight, she sought help. Vision of the left eye was 20/100. In a large, 3.5 disc-diameter circle there were many white spots of atrophic choroid about a 0.25 disc-diameter white macular scar with a few scattered pigment dots.

9. *Drusen, choroiditis, cholesterin*. Mrs. H. M., aged 66 years, had had trouble with her eyes for 20 years. Systolic pressure was 160 mm. Hg. Vision of the right eye was 10/200. The disc was clearly and distinctly outlined; the veins and arteries normal. Throughout the entire fundus, especially in the posterior pole, were many gray spots. Some were quite large and all were beneath the retinal vessels. The center of the macular region was degenerated, grayish-brown, with several brilliant plaques of cholesterin.

10. *Drusen* (March 21, 1939). Mrs. E. W., aged 60 years, had been photographed for eight years. She had extensive drusen in both eyes and, by comparing the first picture with the second, the evidence of growth was incontrovertible. Vision of the left eye was 20/30. The deposits, all beneath the retinal vessels, were confined to a circummacular area. In some of the larger spots fine pigment was visible.

11. *Drusen* (April 4, 1945). The colloid masses had increased in size but were overshadowed in the center of the macular area where there was a pale, 0.5 disc-diameter spot of partial choroid absorption.

12. *Choroiditis*. Mrs. B. M., when she was 68 years of age, had extensive perimacular degeneration with many bright, shining spots and several pigmented specks near a one disc-diameter depigmented center. The vision in this, her right eye, was 20/100. The left eye was the same. Her general physical condition was excellent.

PLATE 1

fast classes but will, if used as intended, aid in the early correct diagnosis.

1. Those which may develop at any time from birth to death and, although seen in advanced age, are not the result of senescence.

2. Those found most often in the old but which may appear in the young.

3. Those present only in the elderly.

The citation of some of the signs which were present at the time of the primary visit to an ophthalmologist will prove that there is a genuine need for a deeper understanding of the course of senile macular disease.

It was found that in some the first sign was a faint grayness of the retina with a slight fogginess but without a sharp definition of the border and very little or no retinal elevation.

In many there were pigmented, punctate granules, in others a well-outlined, round, gray, slightly raised area, while in some there was an ill-defined gray region and in others

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PLATE 2 (BEDELL). *Drusen and exudate.* (This is an excellent example of the similarity of drusen and exudate. If the patient had been seen only once, there might have been some confusion in the mind of the examiner, but, after observing her for many months, all doubt was dispelled and the true nature of the yellow spots was recognized.)

Mrs. J. S., aged 64 years, had systolic pressure of 180 mm. Hg. Four pictures of the left eye and five of the right illustrated some of the difficulties in distinguishing drusen from exudates, then there was a massive red hemorrhage with many soft, gray-yellow spots on its surface.

1. *Senile macular degeneration, exudative.* Left eye, vision: 20/200. An irregularly oval central area larger than one disc diameter and paler in color than the rest of the fundus had an outlining surface pigmentation. There were several exudates, discrete and confluent, the most prominent ones were between the disc and the macula.

2. February 2, 1945. The macular area was much larger, more than two disc diameters, with a soft, yellow-gray indefined border. Some of the smaller exudates had disappeared but larger ones had spread above the central area and to the upper and outer side. A flat, bright red, granular hemorrhage was above it, while below there was a large, thicker extravasation giving a dark-pink appearance to that portion of the fundus.

3. The large, superior macular hemorrhage was photographed from another angle.

4. November 17, 1945. The exudate spots were markedly decreased in size and number. The granular hemorrhage had disappeared and in the macular region there was an irregular X-shaped white choroidal scar.

5. January 7, 1944. Right eye, vision: 20/200. In the macular region there was a pale area one disc diameter in size. Surrounding the center, palest portion, there was an uneven, slightly granular ring with a faint cloud. Widely scattered yellow-white exudates were in a large circle about the macula.

6. May 16, 1944. The macular area was more uniformly yellow-gray. The cloud cap was much wider and longer. Some of the exudate spots reached the cap but the most striking feature was the decrease in their size.

7. September 20, 1944. The center area was smaller, not quite a disc diameter in size and the cloudy-gray cap covered more surface than the central area.

8. February 2, 1945. A several disc-diameters, flat, granular, red hemorrhage partly encircled the macula. The exudate spots were smaller and the cloud was almost indistinguishable from the central area.

9. November 17, 1945. Many of the exudates had disappeared. A few discrete ones remained above the disc. The large hemorrhage had almost vanished but a new one occupied the region between the disc and the macula.

10. *Retinochoroiditis.* W. B., aged 52 years, had vision of the right eye of 20/100. The lens was clear. There were many thin clouds and shreds in the vitreous. The disc was well outlined with several lustrous plaques about and below the macula.

11. *Senile macular degeneration* (August 20, 1942). Miss M. H., aged 81 years, had systolic pressure of 176 mm. Hg. Her vision had been failing for six months. Five years ago she fell, striking her head, and had double vision for a time. Vision of the right eye was 1/200. There was a large mass of fresh blood in the choroid to the temporal side of the fundus impinging upon the macula.

12. April 27, 1944. Extensive infiltration in the macular region with a few fresh hemorrhages and several flecks of pigment.

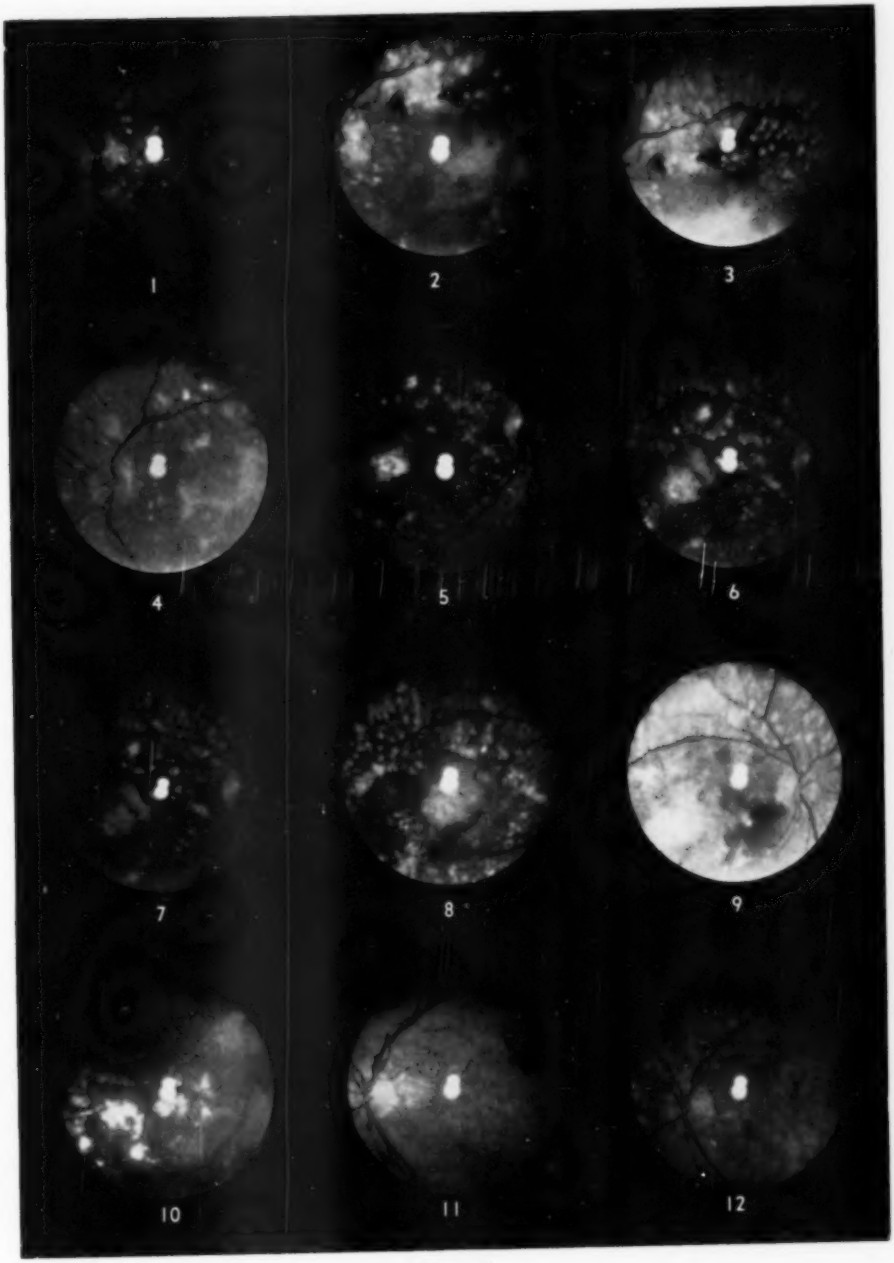

PLATE 2

the gray area was surrounded by a ring of granular, flat hemorrhage.

Sometimes the macula was darker than normal without any demonstrable elevation or depression. In others, the area was flat, a pale gray or a dull pink with irregular pigmentation of its surface and border.

Many times the patient was seen when there was only a single pigmented spot or one flat, rounded hemorrhage. Occasionally, the macula was yellow and flat, and not uncommonly irregularly rounded spots of destruction were sufficiently large to produce a light background with a few choroidal vessels crossing over it.

Frequently, the disease was so far advanced in time and in degree that there was a large yellow-gray elevation of the retina with umbilicated center, or the central mass was so great in thickness and covered so large a surface that it bulged forward into the vitreous. The degree of pigmentation in such lesions varied from thick, almost black sheets to fine, scattered, pinpoint dots. Between these extremes, all sizes were encountered.

Some patients did not seek help until the macular area was totally disintegrated with a complete or partial ring of yellow-white exudate spots close to the margin of the lesion or separated from it by a measurable clear zone, the so-called retinitis circinata.

The difficulties in differential diagnosis became manifest when the elevation in the macular region was great and the irregular pigmentation marked.

In benign melanoma the grayish brown area was usually flat, well-defined, and crossed by the retinal vessels. Sometimes it was unevenly raised, mottled, and the site of abnormal, superficial vessels.

In congenital grouped pigmentation the spots were usually in one quadrant. The smallest were near the disc. They never presented a diagnostic problem.

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PLATE 3 (BEDELL). 1. *Senile macular degeneration, exudative* (May 23, 1942). I. B., aged 80 years, had systolic pressure of 200 mm. Hg. A three disc-diameter area, including the macula, was depigmented. Directly in the macula was an oval, gray-white spot with a faintly pigmented edge.

2. June 15, 1945. The gray center was reduced in size. The surrounding portion was flatter with a few lacelike deposits near its upper outer edge.

3. *Macular exudates* (January 5, 1944). Mrs. E. A. was 60 years of age. The sight had been blurred for two months. Vision in the left eye was 20/70. The macular region was studded with bright spots very similar to drusen with some marginal areas of lacelike exudate.

4. March 3, 1945. The spots were less distinct. The distal lace exudate was greater.

5. January 16, 1946. The exudates were still paler and the lace portion was a smaller, silvery sheet. There were a few granular hemorrhages.

6. *Choroidal vessel sclerosis.* Mrs. D. R., aged 74 years had blood pressure of 140/80 mm. Hg. Vision in the right eye was 6/200. Extending from the disc were six oval areas of choroidal absorption. The macular region was occupied by a three disc-diameter, muddy-gray, elevated area on the surface of which were three dark red hemorrhages.

7. *Choroidal vessel sclerosis.* H. S., aged 70 years had vision in the left eye of 20/200. There were four distinct areas of choroidal vessel sclerosis shining through depigmented spots of variable size, the largest one occupied the macula. Surrounding these were several bright exudate spots.

8. Right eye, vision was 18/200. Several small, choroidal scars surrounded a pale, ovoid, depigmented macular area, on the base of which the choroidal vessels were visible. The borders were heavily pigmented.

9. *Senile macular degeneration, exudative.* E. F., aged 64 years had had failing vision for one year. Systolic pressure was 140 mm. Hg. Left eye, vision was 20/100. There was a two disc-diameter, puckered, gray macular scar with a few pigment spots on its surface and a ring of exudates.

10. *Retinitis punctata albescens.* Mrs. R. H., aged 45 years, had been under observation for many years with a retinitis punctata albescens.

11. The macula was depigmented with a black border.

12. *Pigmentary retinopathy.* The last picture taken shortly before death, when she was 81 years of age, showed an increase in the macular destruction with an intensification of the pigment border.

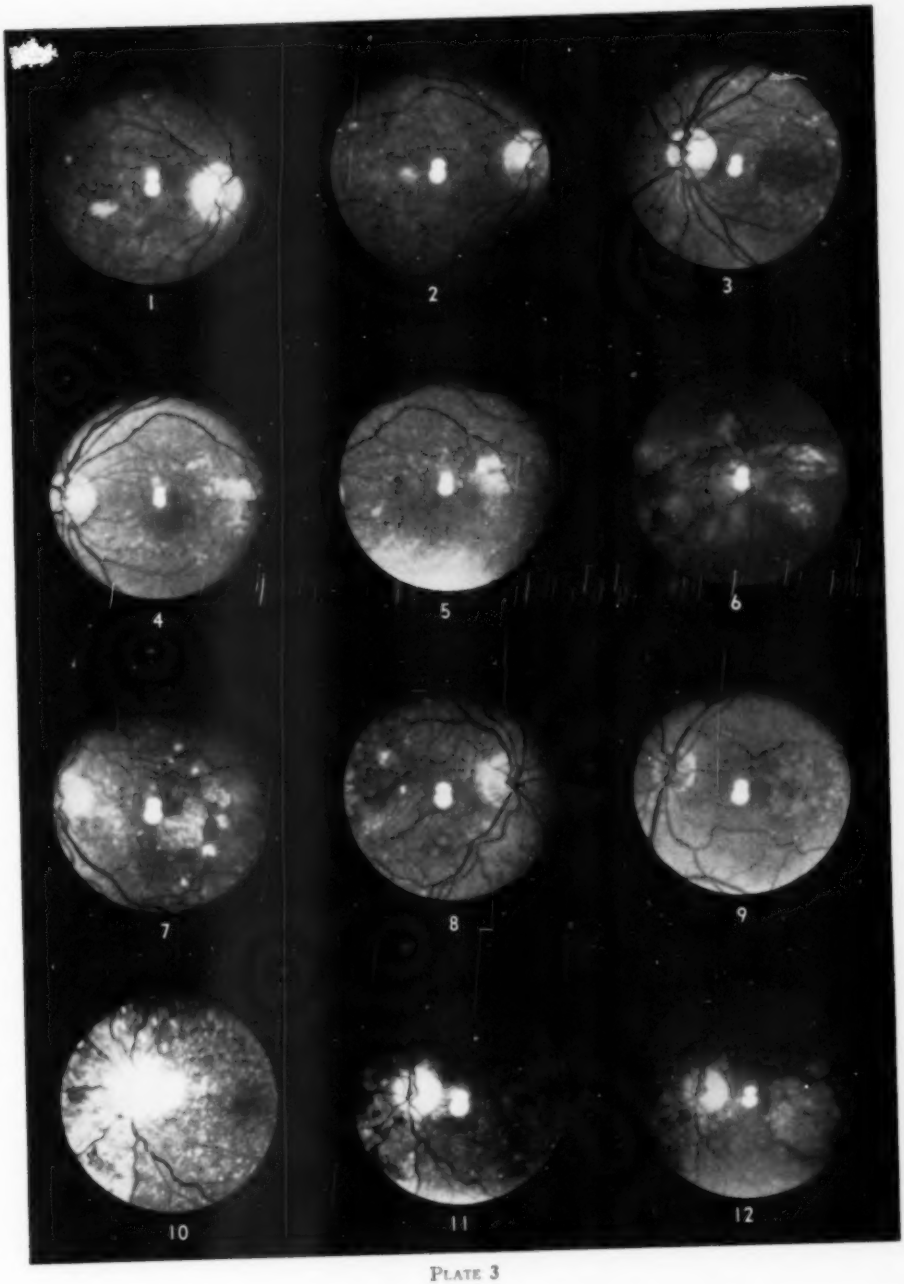

PLATE 3

In malignant melanoma the circumscribed, dark tumor was only slightly elevated with a translucent retina or a large, bulging, globular mass, or nodular, uneven-surfaced, irregularly outlined protrusion both with and without pale spots of lessened pigmentation.

The diagnosis is usually correctly made by the analysis of repeated photographs. When the mass is enlarging and the pigmentation increasing, a growth is suspected, and if there are no pathologic retinal or choroidal vessels, a tumor is considered most probable.

A very large, choroidal hemorrhage simulated a neoplasm. It was elevated with a smooth surface and sharply defined border. There were many differences in the caliber of the arteries and the several retinal exudates. After two weeks of observation, all doubt was dispelled for the dark mass was smaller. The clot disappeared and a choroid scar became visible.

It must not be inferred that even with photographs the diagnosis can always be made on the first visit. Such is not the rule, but it can be stated that no suspicious or doubtful case should be considered to have had a complete examination until the study of clear photographs confirms the diagnosis.

An elderly patient may present a great variety of fundus signs and care is necessary to place them in the life cycle of either an inflammatory or degenerative macular disease.

Drusen, colloid excrescences, may be pres-

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PLATE 4 (BEDELL). 1. *Retinal veil.* D. W., a very frail 83-year-old man, had a systolic pressure of 152 mm. Hg. Left eye, vision was 1/200, with a −7.0D. sph. ⊂ −5.0D. cyl. ax. 90° = 20/50. A 2.5 disc-diameter golden fleece partially covered the retina in the macular region. The right eye was similar.

2. *Retinal veil.* Mrs. A. P. was 63 years of age when the vision of her left eye was 20/100. The blood pressure was 142/100 mm. Hg. In the macular region there was a thin veil on the retina with many small openings. The right eye was the same.

3. *Macular exudates.* H. M., aged 77 years, had failing sight for one year. Systolic pressure was 156 mm. Hg. Right eye, vision was 20/100. Irregular depigmentation in the macula was clearly seen on a bleached background.

4. *Organized exudates.* Left eye, vision was 20/200. The disc was surrounded by a ring of choroidal atrophy and a large, pale, oblong area, a partial coloboma of the choroid. The macular scar was oval with a slightly elevated, white crescentic band close to the faintly pigmented, flatter center, with a few small vessels in it. There was one dot of blood.

5. *Macular exudate.* Mrs. B. N., aged 59 years, had vision in the right eye of 3/200. Her sight had been failing for five months. In the macular region was a large, yellow cyst with a level upper margin.

6. *Senile macular degeneration.* J. D. was 62 years of age. Vision of the right eye was 2/200. The macular region consisted of a flat, yellow square above a 1.0 by 2.5 disc-diameter, curved, white prominent band and many scattered flecks of pigment.

7. *Diabetic retinopathy* (April 13, 1938). Mrs. N. H., aged 62 years, had had mild diabetes for a short time. The blood sugar was 100 mg. percent. Left eye, vision was 6/200. The retinal veins were dilated and the arteries slightly smaller than normal. Many yellow-white exudates were about the macula. There were a few, round, red hemorrhages, minute aneurysms and several thin streaks of blood.

8. September 5, 1938. The blood sugar was 157 mg. percent, and the systolic pressure, 160 mm. Hg. The vision was 20/200. A broad, yellow ring of exudates surrounded the macula, the form often alluded to as circinate.

9. *Retinal exudates* (June 19, 1941). J. B., a 69-year-old man, had a systolic pressure of 140 mm. Hg. Right eye, vision was 1/100. A nebulous arc of small lacelike exudates was about a small macular hemorrhage.

10. October 8, 1941. A crescent of small, bright exudates partly encircled the macula on which there were several small hemorrhages.

11. January 27, 1942. The collar of exudates had broadened and the macula was more swollen and gray.

12. *Senile macular degeneration, crown of exudates.* Mrs. C. H., a woman, aged 72 years, had a systolic pressure of 130 mm. Hg. The vision in the left eye was 1/200. The right had the same degeneration. Seven months after the first picture, the exudates had so increased that the dark hemorrhage-spotted macula was almost completely surrounded.

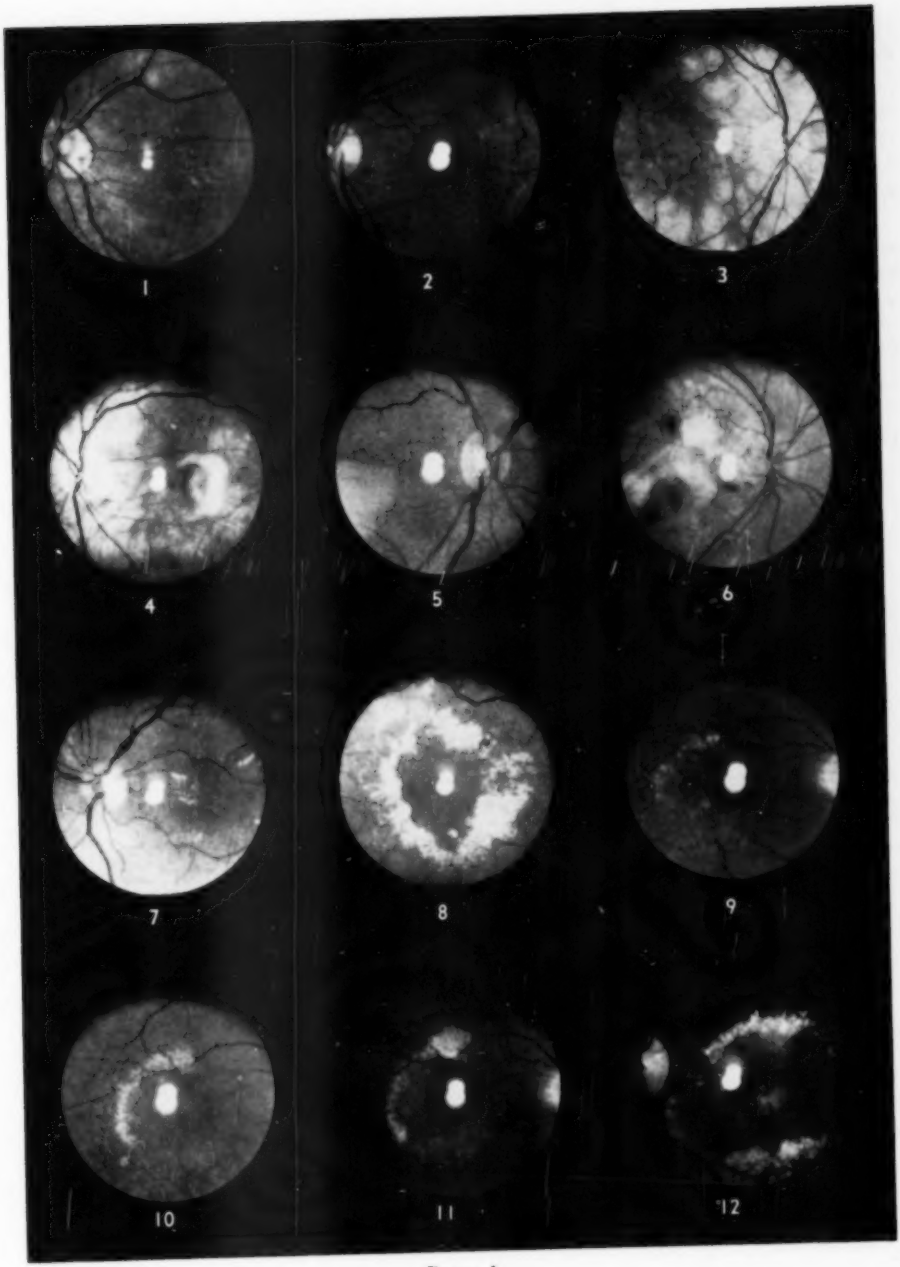

PLATE 4

ent from childhood to death. The early individual lesions are small, discrete, and bright yellow, commonly found in the posterior portion of the fundus, in the macular region, or only to the nasal side of the disc. They may increase in number and size or remain almost stationary for years.

The drusen of the elderly are often, however, clinically different, flat, or slightly elevated, gray-yellow areas lying beneath the retinal vessels. As the patient grows older, differences in size, thickness, and color of the individual and collected masses cover such a large range that errors in diagnosis are frequently made. This is especially so when the drusen increase in thickness to such an extent that pigment is distributed on and between them. Very large drusen may coalesce and cause some reduction in central visual acuity. Confusion is increased when, superimposed upon drusen, there is an absorption of the choroid, macular degeneration, or massive exudates.

Drusen grow and may, by the simple increase in volume, push the pigment to one side and, further, they may disturb the retinal elements causing not only a reduction in the central vision but also, and not uncommonly, a distortion of objects. It is obvious that with this combination of signs and symptoms the early stage of a more destructive disease may not be appreciated and the true significance of the changes not evaluated until the visual loss is considerable.

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PLATE 5 (BEDELL). 1. *Early macular degeneration* (November 14, 1942). J. K., aged 72 years, had generalized arteriosclerosis. Left eye, vision was 5/200. Systolic pressure was 162 mm. Hg. Sight had been defective for two years. There was a small, 0.25 disc-diameter, pale-pink macular area surrounded by bright red blood with an outer wall of small exudates.

2. January 16, 1943. The lacelike border almost encircled the macular hemorrhage.

3. February 5, 1944. The oval of exudates was decidedly smaller.

4. *Senile macular degeneration, exudative* (October 8, 1942). Mrs. E. R., aged 55 years, had blood pressure of 220/110 mm. Hg. At a later date it was 234/108 mm. Hg. Right eye, vision was 20/50. A perfect circle of exudate spots was above the macula and was crossed by the superior temporal vessels. Scattered about the region were many fine, discrete dots with one small choroidal scar.

5. July 8, 1943. The diameter of the crown of exudate was larger but the exudates were fewer. The circle was broken and a second 2.5 disc-diameter ring impinged upon the temporal side of the macula.

6. *Senile macular degeneration, exudative*. Mrs. S. G., aged 61 years, had systolic pressure of 160 mm. Hg. She had known that her sight was failing for 18 months. She had albuminuria. Right eye, vision was 2/200. Many fine exudates were scattered about the disc. In the macular region there was a large plaque of exudate with a sharp, thick, horizontal edge.

7. *Senile macular degeneration, exudative*. Mrs. W. G., aged 67 years, had systolic pressure of 260 mm. Hg., with arteriosclerosis and hypertension. Left eye, vision was 1/200. The macular area was occupied by a six disc-diameter, white, flocculent mass with a frayed edge of smaller dots. There were several hemorrhages scattered about the edge of the mass and also in the comparatively clear center.

8. *Round macular degeneration*. E. F., aged 64 years, had vision of the right eye of 20/100. The macular region was a pale circle of about one disc diameter, enclosed in a linelike ring of blood and pigment. Exudate spots encircled it.

9. *Round macular degeneration*. Mrs. H. B., aged 67 years, had systolic pressure of 150 mm. Hg. Right eye, vision was 20/100. The pale macular area, partly surrounded by scattered pigment specks, was a little larger than one disc diameter. There were many flat exudates and several lustrous plaques.

10. *Postinflammatory hole in the macula*. Mrs. F. C., aged 19 years, had vision in the left eye of 20/200. There was a large, red-based macular hole and also a white connective-tissue mass over the inferior temporal portion of the disc.

11. *Senile macular degeneration, exudative*. Mrs. L. P., 68 years of age, had systolic pressure of 168 mm. Hg. Right eye, vision was 1/200. A large, two disc-diameter, white, elevated mound in the macular region had two narrow, hornlike projections above and one below.

12. *Retinitis proliferans*. Mrs. V. G., aged 63 years, suddenly discovered loss of sight in the right eye. Systolic pressure was 260 mm. Hg. There was a markedly contracted field with a central scotoma. Right eye, vision was 1/200. The macular area was swollen and gray, with a white crescent near its center.

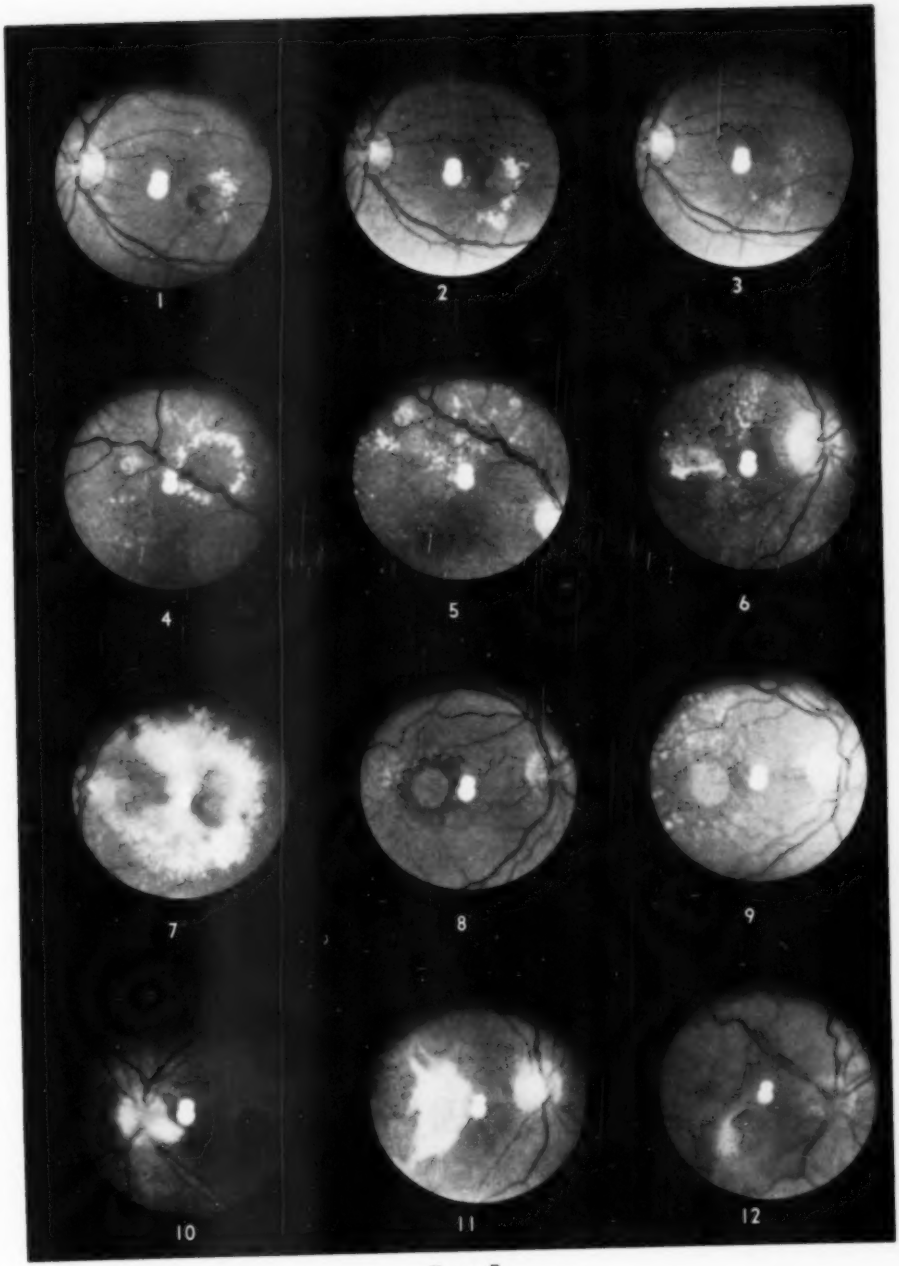

PLATE 7

The deposits may become so large and so heavily pigmented that the uninitiated may diagnose the condition as retinochoroiditis. The vision may be reduced when the drusen are gross, closely packed together, or when there is a concurrent choroidal destruction with a pale, pink, flat, unevenly pigmented round or ovoid center.

The majority of patients with drusen show binocular involvement. The colloids vary in size from pinpoints to spots larger than the widest part of the retinal vein.

The central drusen may be much larger, softer, and less defined than the outer encircling ones. The entire macula may be covered with small dots. Big and little drusen may surround the disc and the macula. Often there is a pale, confluent, central aggregation in one eye and irregular pigmented lines in the other. The macula may be a one disc-diameter, flat, more or less rounded area with a pale, outlining circle, or a thin, pigmented marginal line.

Sometimes, large, soft, gray spots are about the macula with many fine dots arranged as a ring beyond them. Gray drusen with pale centers may be outlined unusually well, or be so bright that they are almost

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PLATE 6 (BEDELL). 1. *Macular edema* (March 23, 1945). Mrs. S. B., 72 years of age, had systolic pressure of 138 mm. Hg. She was very frail. Right eye, vision was 20/40. The macular region was edematous with a bright red oval of hemorrhage about 0.2 disc diameter in size. To the lower outer side of the region there was a thin fleck of hemorrhage.

2. *Senile macular degeneration, exudative* (June 19, 1946). The ring of exudate was almost complete with new collections extending from the border where part of them merged into a large, softer mass.

3. June 19, 1947. The site of the first exudate arc was occupied by a dark-red crescentic hemorrhage. Above the edematous macula there was a horizontal arc of lacelike exudate and to the inferior and temporal portion a larger, thicker mass of similar type beyond which the absorbing thick area was evident with a very faint hemorrhage.

4. October 14, 1947. The change was very marked. The almost complete ring of exudate was wide and thick. The outer portion remained cloudy yellow, while beneath the circle there was a larger mass of exudate.

5. *Senile macular degeneration, exudative.* Mrs. A. H., 65 years of age, had systolic pressure of 154 mm. Hg. She happened to discover the poor sight about four weeks before her first visit. Right eye, vision was 3/200. The macular region was thick, pale, and definitely outlined about 0.25 disc diameter in size. A large, C-shaped, lacelike exudate covered the upper and outer portion of the lower border and was separated from the center by a comparatively clear zone.

6. *Senile macular degeneration, exudative* (September 17, 1943). Mrs. M. N., aged 55 years, had systolic pressure of 108 mm. Hg. This patient was examined one year after the sight of her left eye had failed. A 60-degree central scotoma was present. Left eye, vision was 1/200. Surrounding a two disc-diameter elevated macular region was a thick, soft appearing, yellow exudate with a very sharply defined, fingerlike extension.

7. July 12, 1945. A lacelike border of exudate encircled the degenerated macular region with its irregular pigmentation and faint hemorrhages.

8. March 25, 1949. The lacelike border was much decreased in extent and thickness. The macula was more degenerated and a muddy gray and the pigment was greater.

9. *Senile macular degeneration, exudative* (October 2, 1940). Mrs. A. W., 69 years of age, had systolic pressure of 238 mm. Hg. She had a left-sided facial paralysis and circulatory accident involving the tongue, left side of face, and arm. Six weeks previously, the right side was similarly affected. Left eye, vision was 1/200. There were a few, small, red hemorrhages to the nasal side of the disc. The macular area was dark with granular pigmentation about one-third disc diameter. Between it and the disc there was an irregular patch of soft, yellow exudates of the lace type.

10. May 15, 1942. The exudate patch was larger and many fresh, superficial, flame-shaped hemorrhages were below the disc.

11. January 28, 1943. There were a few new hemorrhages above the macula. The exudate was in the form of an inferior arc.

12. May 5, 1944. There were a few hemorrhages in the macula. The exudates between it and the disc were much thicker and more homogeneous. The lace portion was smaller except in the outer pole.

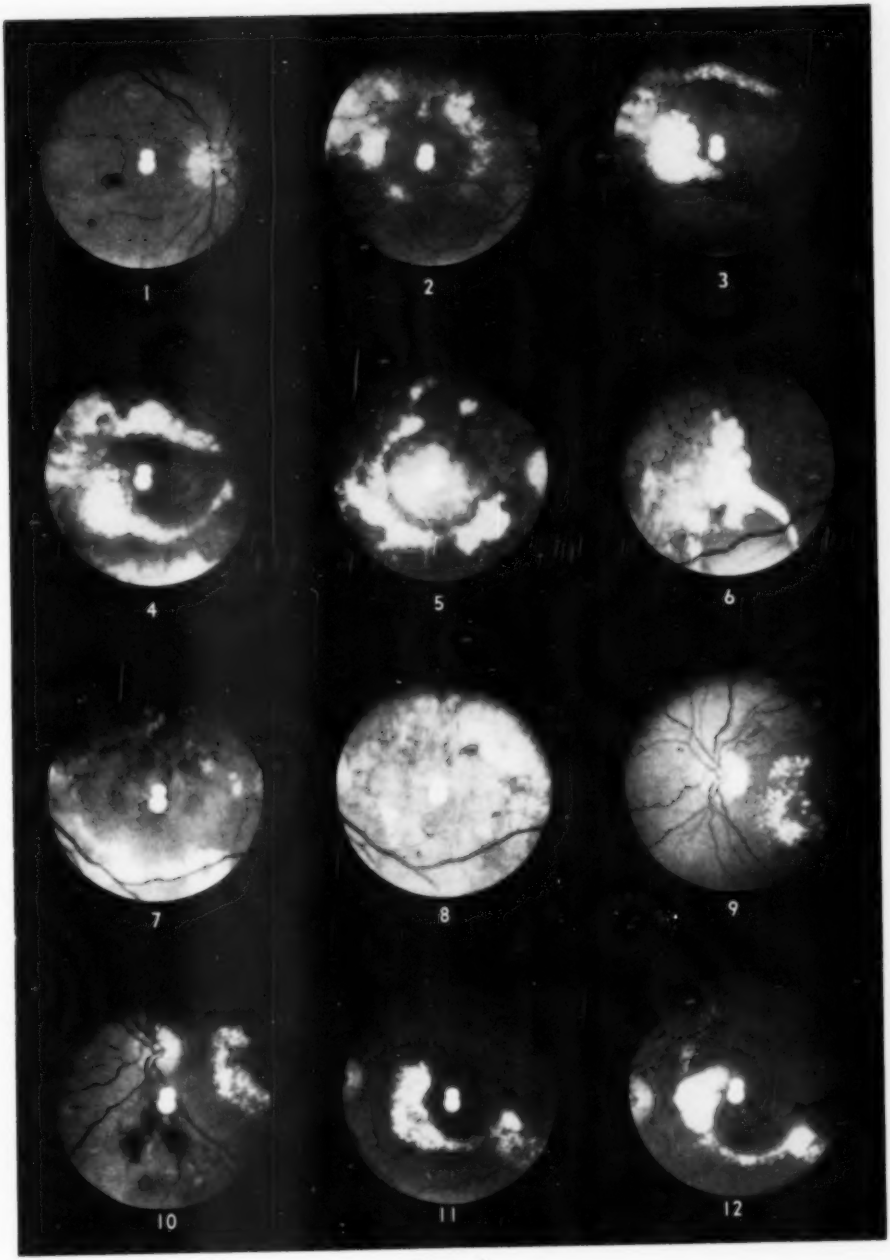

PLATE 6

white; or they may be associated with brilliant, light-reflecting cholesterin crystals.

When a macular degeneration develops in an eye with large colloid collections, it passes through the same stages as any similar degeneration, but the drusen may obscure some of the details and in that way lead to an incorrect appraisal of the condition.

Senile drusen invariably increase in size. This has been confirmed by serial photographs. It is, therefore, apparent that drusen may be placed in all three groups.

Group I alterations are so numerous and so varied in appearance as to size, color, and form that they are only mentioned in this communication.

The changes in this group, those which may develop or be discovered at any time in life, include congenital anomalies and the so-called macular colobomas. Both of these may escape recognition until the patient develops poor vision in the unaffected eye.

Following trauma there may be a rupture of the choroid, a hole in the macula, or a retinochoroiditis with irregular deposits of pigment on a depigmented background.

Ovoid scars of former choroiditis closely resemble senile changes by their irregular pigmentation. There are, however, definite clinical differences in the surface, at the rim, and in the retinal vessels.

Among the rarer changes are scars, the result of a central conglobate tubercle, the disfigured macula following thrombosis of the

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PLATE 7 (BEDELL). 1. *Senile macular degeneration, hemorrhagic* (September 7, 1940). Mrs. C. K., aged 64 years, had blood pressure of 120/80 mm. Hg. She had known that the sight of the right eye was poor for nine months. She had been treating for sinus trouble. A large, four disc diameters, circle of blood enclosed an elevated, cloudy macula. To the nasal side of the hemorrhages were many pinpoint exudates.

2. *Exudative.* The diffuse macular hemorrhages had all disappeared leaving a gray, slightly elevated macula and an ill-defined circle of exudates.

3. *Retinochoroiditis.* C. D., aged 39 years, showed a negative Wassermann test. His eye complaint was of five months' duration. Right eye, vision was 10/200. There was a group of several small exudates on the inferior border of an irregularly pale, one disc-diameter macular area, with a faint hemorrhage forming its lower border.

4. *Senile macular degeneration in diabetes.* Mrs. A. H., aged 70 years, had been a diabetic for two years. Vision had been failing for two years. Systolic pressure was 140 mm. Hg. Right eye, vision was 1/200. A four disc-diameter macular area was partially outlined with lacelike exudate above a homogeneous mass below.

5. *Senile macular degeneration, exudative.* Mrs. B. P., aged 72 years, had systolic pressure of 150 mm. Hg. Left eye, vision was 1/200. An example of an early, so-called circinate retinitis, with a partial crown above and many hemorrhages near the lower border of a partly depigmented macula.

6. *Senile macular degeneration, exudative.* Mrs. M. B., aged 81 years, had systolic pressure of 160 mm. Hg. Right eye, vision was 1/200. The broken ring of exudates encircled a three disc-diameter macular area with slightly irregular pigment.

7. *Senile macular degeneration, exudative.* Mrs. A. V., aged 78 years, had systolic pressure of 160 mm. Hg. She had been unable to read for one year. Left eye, vision was 8/200. A 2.5 disc-diameter macular area was pale and enclosed by an indefinite crown of lace exudates.

8. *Senile macular degeneration, exudative.* (June 10, 1948). G. S., aged 53 years, had two weeks previously noticed distortion of vision in his only eye. The left eye had been removed following an accident. Right eye, vision was 20/100. A two disc-diameter ring of soft, almost-white exudate spots surrounded the macula.

9. May 27, 1949. Vision was 20/200 with a five-degree central scotoma. The circle of exudate was about twice as large and consisted of minute dots.

10. *Senile macular degeneration, exudative.* C. C., aged 70 years, had vision of the right eye of 1/200. A large oval, about seven disc diameters, surrounded a depigmented zone in the center of which was a large, gray, soft, elevated mass. The outer rim was of the so-called circinate type of exudate.

11. *Senile macular degeneration, exudative* (November 30, 1944). Mrs. L. L., aged 60 years, had blood pressure of 190/80. Left eye, vision was 5/200. A large, bright triangular area of whitish exudate extended from the temporal side of the disc downward beyond the macula.

12. May 3, 1945. The exudate had contracted to an oval slightly smaller than one disc diameter. Vision was 1/200.

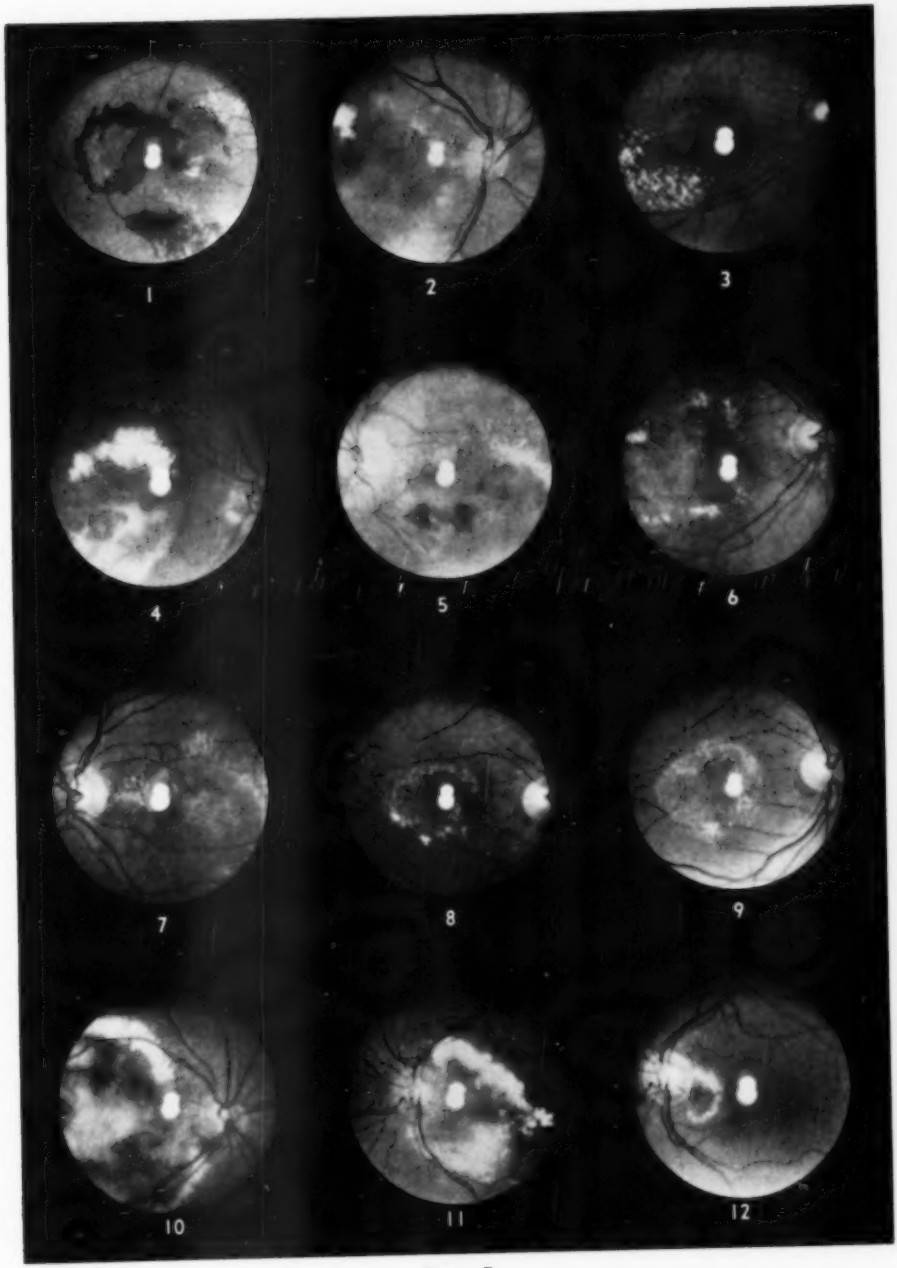

PLATE 7

central retinal vein and the so-called juvenile macular degenerations.

A cyst of the macula may develop at almost any age. It may be very small, flat, and sharply outlined, or two disc diameters in size with a well-defined border and appear pale, almost transparent, translucent, or yellowish. The larger ones are probably found only in middle or late life. They must not be confused with preretinal edema, the so-called central serous retinitis, a condition which has been incorrectly diagnosed as central detachment of the retina.

Group 2 changes which may be found in patients before they reach old age, but which may develop later, include the macular de-

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PLATE 8 (BEDELL). 1. *Senile macular degeneration.* M. S., a 67-year-old woman, with a systolic pressure of 150 mm. Hg., complained of poor vision and had a complete central scotoma in each eye. Right eye, vision was 20/50. The fundus findings were negative except in the pale, pink macular region where there were a great many small, pigmented collections irregularly arranged in three nearly vertical lines.

2. *Senile macular degeneration, exudative.* Left eye, vision was 20/100. An incomplete ring of small dots of exudate encircled a thin, red hemorrhage and a few deep retinal exudates in the macular area. The inferior portion of the exudate circle was the widest.

3. August 28, 1946. A complete band of exudate surrounded the oval macular region which was an elevated, yellow-gray mass with several small hemorrhages near the lower margin. The retinal vessels passed over the exudates.

4. June 13, 1946. The ring of exudate had enlarged and broadened to enclose the obliquely oval unevenly surfaced macular area. The central portion, about two disc diameters, was the most involved. There were several small, bright red linear hemorrhages between this part and the inner margin of the inferior exudate crown.

5. April 15, 1947. The three disc-diameter macular area was elevated, uneven, and mottled with two incomplete rings of exudate. The inner was a flat, gray, V-shaped band close to the outer, upper, and lower margin of the macular region. The other a deep, yellow, flat, narrow circle was complemented by the former, a large crescent, densest inferiorly. There were many fine exudates similar to but brighter than those present at the first examination.

6. October 22, 1948. The enlarged, four disc-diameter macular area was a prominent 2 to 3 disc-diameter grayish mass with uneven surface, dense pigmentations above, thin choroidal vessels in parts of the floor and several small, fresh hemorrhages. The lower half was partially covered by a broad 0.5 disc-diameter gray sheet which curved over the central scar.

7. *Senile macular degeneration.* (An excellent example of the transformation of a few exudates to a thick, gray band while the macular area became an elevated, disorganized mass. Even after several years new hemorrhages appeared.)

September 30, 1943. L. P., a 63-year-old woman, was under observation for three years. She had hypertrophic arthritis. Blood pressure was 184/102 mm. Hg, with generalized arteriosclerosis. After three months of poor vision, she presented with vision in her left eye, 20/50, and a 10-degree oval central scotoma. The retinal veins were full and the arteries small. The 1.5 disc-diameter macular region was gray and edematous, with faintly speckled pigmentations and several small dots of blood close to the vessels which crossed the upper edge of the pigment.

8. October 18, 1943. The hemorrhages were larger and extended above the crossing vein. There were a few extravasations near the center of the area which was larger and more varied in color.

9. September 30, 1943. The right eye (vision of 20/30) remained unchanged. It is shown because of the irregular oval of finely pigmented specks above an unevenly depigmented macula. A nonexudative form.

10. December 6, 1943. Subjectively, the chief complaint was frequent flashes of blinding light. Left eye, vision was 20/200. An irregular, circular band of blood, about three disc diameters, embraces the macular region with a pale center and a ring of pigment. The hemorrhages were broad or small dots and the retinal vessels were not covered by them.

11. February 22, 1944. Left eye, vision was 6/200. Systolic pressure was 220 mm. Hg. The oval macular region was a gray, prominent swelling nearly two disc diameters in its largest vertical diameter. The blood had almost completely disappeared in lower disc side quadrant and was thinner in every other part.

12. December 16, 1944. Vision was 20/200. A rounded, gray mass about the size of the disc occupied the macular region and was surrounded by a flat, dark ring about one third as wide. *(A classical onset and termination.)*

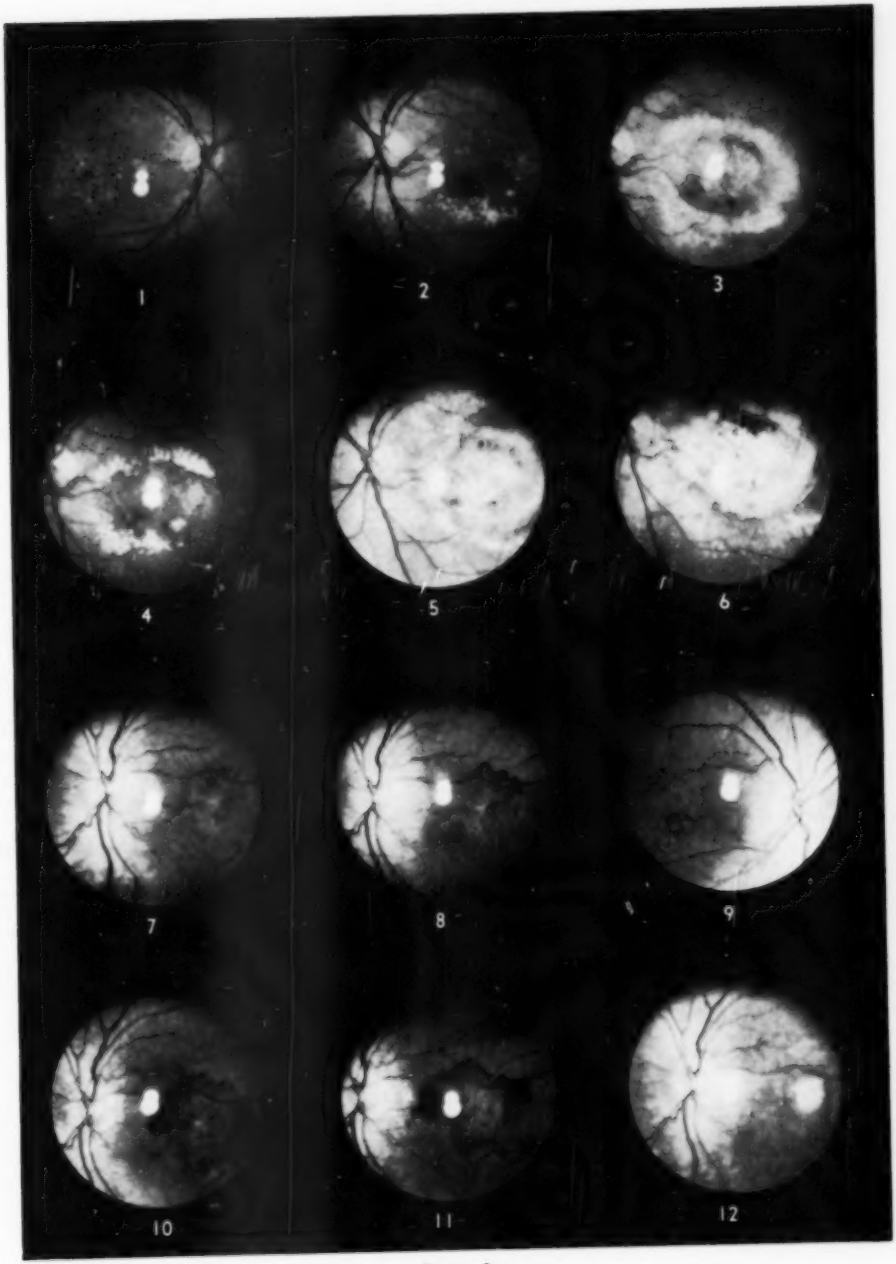

PLATE 8

generation found in advanced angioid streaks, the macular star of hypertension or nephritis, or any of the numerous types of retinitis or choroiditis, also the infinite phases of the retinopathy of diabetes and those which result from glaucoma where there is either a macular depigmentation or an irregular deposition of pigment.

Likewise in this group are the macular destructions and retinal tears of high degrees of myopia, where at times the retina and choroid are so stretched that what would be common in a hyperopic eye becomes so distorted and the background so altered that it seems to be a new form. The regional absorption of the choroid in myopia leaves a white scleral patch and, if pigmentation follows, the center may be surrounded by a wide white band.

The vascular states are so numerous that they may be properly placed in the second as well as the third group.

In considering conditions which practically never appear except in the elderly, Group 3, the first is hemorrhage, and this may be divided into that which comes from the retinal vessels and that from the choroidal.

Following a frank thrombosis of one of the retinal veins, the blood may seep over the macula and after a short time the appearance is the same as that of a typical senile degeneration, with practically no evidence of the mode of onset. At other times, the blood from an occluded vein is collected as a ball directly over the macula and, unless the patient has been seen before the development of the globular mass, the real cause cannot be diagnosed. The blood may entirely disappear but the macular region remains disorganized as a flat, yellow-gray, ill-defined area with loss of central vision.

In an extensive macular hemorrhage, the flow of blood may be traced from a broken vessel as a gray, faintly blood-tinged cloud floating from the vein down over the macula. There are other retinal hemorrhages where the blood is widely dispersed over a broad, macular region with several fine, bright dots between it and the disc. This form often passes through a period when a crown of exudate, the so-called circinate, surrounds it.

Following a simple, round, red, macular hemorrhage, resolution may be complete.

The choroidal hemorrhages are most often

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PLATE 9 (BEDELL). 1. *Macular hemorrhage.* J. B. T., aged 64 years, presents an interesting example of a large, macular hemorrhage which subsided and left a gray, flat scar. He had had poor sight for three days. There was a central scotoma close to the 10-degree limit. Systolic pressure was 120 mm. Hg. *(The illustrations show the method of absorption of the blood and the organization of a flat scar.)*

2. May 6, 1946. Right eye, vision was 4/200. There was a large, oval hemorrhage in the macular region. The outer border was a broad white band with gray exudates above the shrinking clot.

3. July 30, 1946. The massive exudates above the macula were decidedly increased in number and size. The outlining white arc was reduced in width and length. There were several dark-red hemorrhages over and to the temporal side of the macula.

4. October 3, 1947. There was a gray, scarred macula with vision reduced to 3/200 and with a 10-degree central scotoma.

5. *Macular hemorrhage* (June 23, 1945). D. L., a 36-year-old man, had vision of the left eye of 20/100. There was a round, macular hemorrhage, about one disc diameter, with a central, brilliant spot.

6. July 2, 1945. The macular hemorrhage was shrinking, decreasing in depth and surface.

7. July 19, 1945. The hemorrhage had disappeared and the vision was 20/20.

8. *Thrombosis retinal vein.* (September 26, 1946). Mrs. F. G., aged 48 years, had vision in the right eye of 3/200. There was a thrombosis of the superior, temporal vein with a widespread extravasation.

9. November 4, 1946. The hemorrhage covered less surface but was much denser.

10. April 22, 1947. Vision, 20/200. The hemorrhage was much thinner. White areas were in the center of the clots and several fine, pinpoint exudates were between the macula and the disc.

11. November 11, 1947. A round hemorrhage occupied the macular region with a brilliant apex dot.

12. January 7, 1949. Vision, 20/70. There was a very faint remnant of the macular hemorrhage.

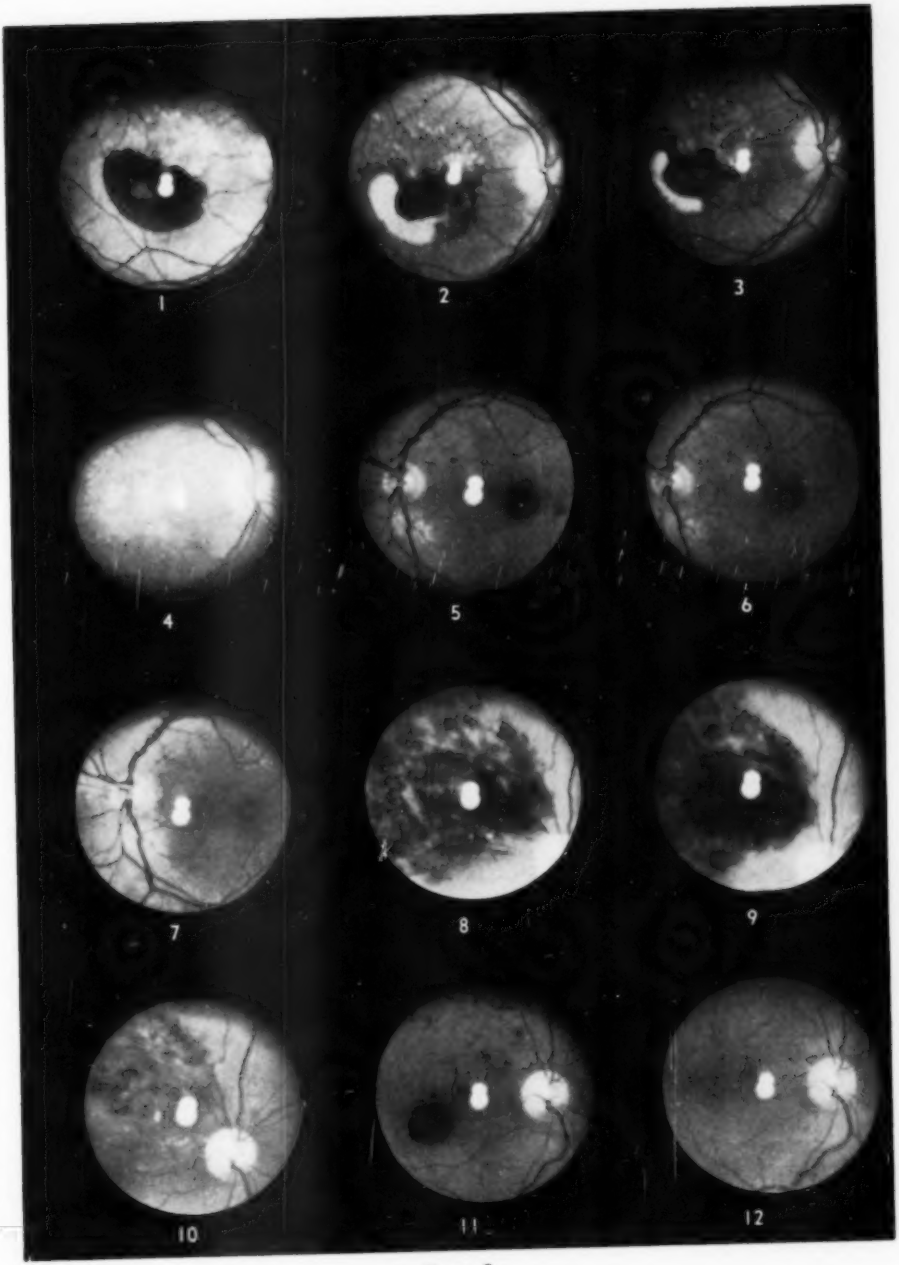

PLATE 9

flat, granular in appearance, and assume a circular form, sometimes a single, small arc at the margin of the macula. They tend to creep around the macula and at the same time expand as a widening circle, sometimes a complete ring but more often only partial. They vary in width from narrow lines to bands almost as broad as the disc. They constantly change and from one week to another it is possible to note decrease in one portion and increase in another. These arcs of blood may appear at any time during the life of the individual but are most often evidence of senility. They may recur after the eye has been quiet for years and are, therefore, very unreliable guides as to the time when the macula was first involved.

Occasionally, a choroidal extravasation is so large, so thick, so dark, and so elevated that it simulates a choroidal tumor. Usually, there are coincident retinal vascular changes and exudates which enable the physician to exclude malignancy.

The choroidal vessels may become sclerosed in small, irregularly scattered spots about the posterior pole. Larger areas of 2 to 3 disc diameters, or most of the visible fundus, may be involved. The twisted, tortuous, white vessels show that they are on different levels with a sharp demarcation between the affected and unaffected portions, a disappearance of the pigment layers.

When a patient is seen at an early stage of sclerosis, the overlying retina is slightly cloudy so that the choroidal vessels are seen as through a fog.

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PLATE 10. (BEDELL). 1. *Senile macular degeneration* (December 23, 1937). B. S., aged 67 years, had had poor vision in his right eye for four years; vision in the left eye had been failing for seven months. Systolic pressure was 130 mm. Hg. The left eye showed a dark-red hemorrhage surrounding the gray, 2.5 disc-diameter macular area. The hemorrhage was uneven in thickness as well as width.

2. January 14, 1938. The blood was distributed in a larger ring. The center was irregularly depigmented.

3. March 16, 1938. There were more hemorrhages covering a much wider area so that they impinged upon the temporal side of the disc and extended about four disc diameters. They were widely separated, some were large, others very small. The macular region was paler.

4. April 15, 1938. The crown of blood was decreased in density and no fresh hemorrhages had appeared.

5. June 25, 1938. There was marked reduction in the size of the hemorrhages. A few fresh ones were at the extreme upper and lower borders of the macular area which was paler in color, with a thin hemorrhage on its surface.

6. August 18, 1938. A few recent hemorrhages were between the inferior temporal vessels. The macular area was still paler, with faint linear granular hemorrhages.

7. December 14, 1938. Some fresh blood was below the lower nasal margin of the disc. The macular area was becoming more constricted and yellow. (*This is a common form of macular destruction.*)

8. *Macular hemorrhage, diabetes, hypertension* (December 18, 1942). Mrs. A. P., aged 70 years, had systolic pressure of 178 mm. Hg. She had been a diabetic for several years. Left eye, vision was 1/20. There was a dark, macular hemorrhage a little larger than the disc in size with a horizontal upper border and bright reflections from the surface. A thin layer of blood extended obliquely from the superior temporal vessels down to it.

9. December 31, 1942. The macular hemorrhage was less dense, the center was pale, and the red cloud above it was larger, almost three disc diameters.

10. January 7, 1943. There had been very little change in the macular blood clot. The upper hemorrhage had increased transversely so that it was nearer the disc, and the two lighter spots were more obscured by a thicker, darker hemorrhage which was a little larger than the macular one.

11. February 19, 1943. The macular clot was slightly decreased. The deeper hemorrhage extended from the temporal side of the disc, almost five disc diameters, as a broad oval zone, with blood in a thin layer close to the disc and an outer upper margin. The dark center of this portion was smaller and the far temporal border was pale with several small dots of exudate.

12. *Macular degeneration* (June 23, 1943). There was a very marked decrease in blood. The macular clot had almost disappeared with only two small hemorrhages above. A few lacelike specks were in a vertical oval, outlining the temporal side of this region. Vision was 20/100. When last seen the systolic pressure was 230 mm. Hg.

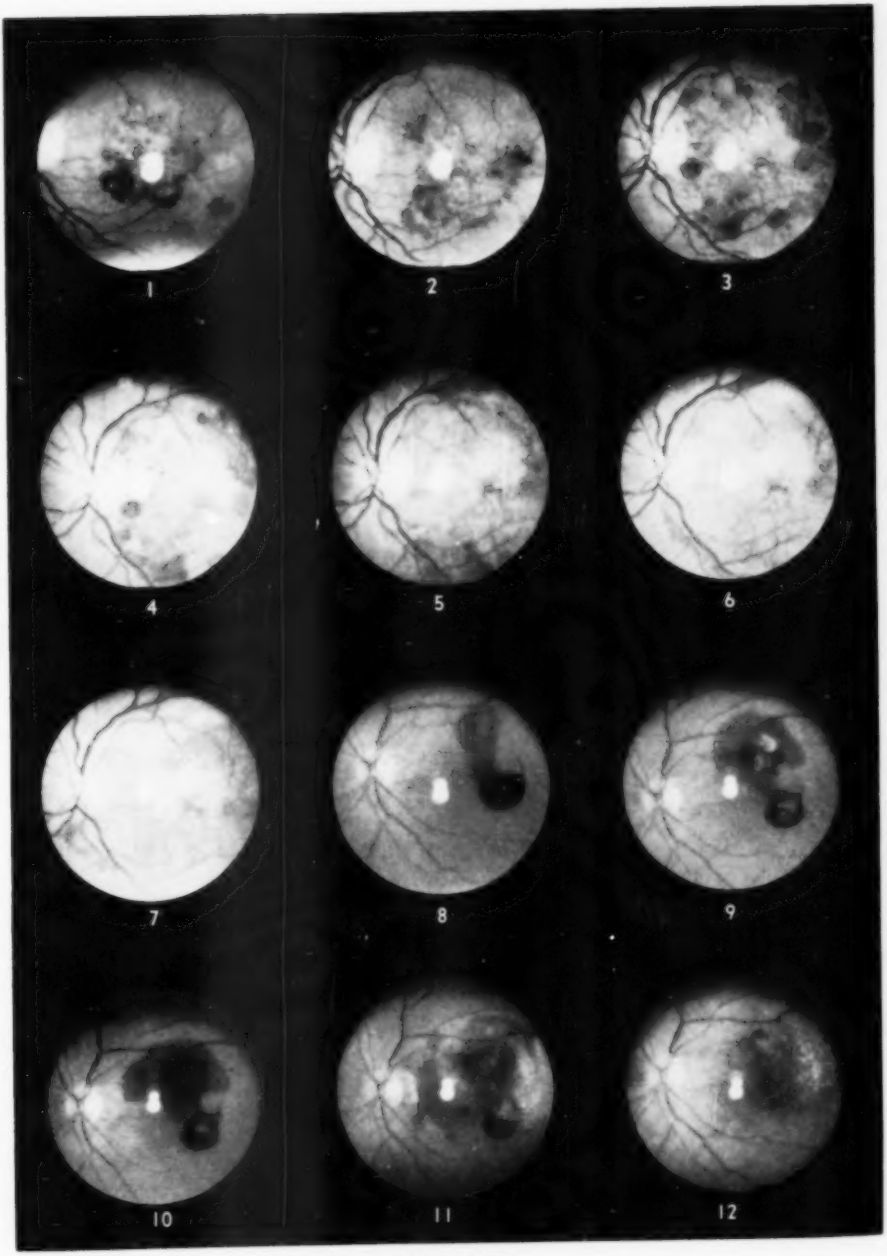

PLATE 10

A severe retinochoroiditis may leave a large, circumscribed region with scattered pigment and markedly sclerosed choroidal vessels.

For many years, retinitis circinata has been described as a distinct clinical entity. An inspection of some of the photographs will prove the fallacy of this contention and show that a circular ring of lacelike exudates may be remote from the macula or greatest adjacent to the temporal side of the disc, or the crown may become a homogeneous band which disappears leaving no trace. While the color and number of the exudates are changing, the encircled macular region becomes more swollen and gray, finally organizing into a thick scar.

Large, macular hemorrhages may be placed in either the second or the third group, for, although they may occur before old age, they

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PLATE II (BEDELL). 1. *Thrombosis, superior temporal vein* (April 27, 1938). (There are times when what appears to be a simple thrombosis of the superior temporal vein is in reality the beginning of a senile macular degeneration.)

Mrs. I. H., aged 43 years, had vision of 10/200 in the left eye. There was a typical thrombotic extravasation in the upper outer quadrant of the fundus close to the disc. The oblong hemorrhage covered a 0.25 by 2.5 disc-diameter space. There were a few yellow specks about it.

2. November 15, 1938. The appearance was characteristic of a senile degeneration. There were several streaks of blood in the macular region, a circular area about 2.5 disc diameters, with many fine pigment specks along its upper margin, some between it and the disc and a very few to the temporal side.

3. March 11, 1939. The macular blood was less, some spots were decidedly pale. There were a few small hemorrhages and a very few exudate dots up and out, close to the border of the lesion.

4. June 10, 1939. There were fresh hemorrhages over the pale macular area and a very few minute exudate specks.

5. December 30, 1939. There were two rounded, pale areas in the macular region with very slight pigmentation between them. No hemorrhages or exudate.

6. *Choroidal hemorrhage.* Mrs. A. B., aged 55 years, had systolic pressure of 158 mm. Hg. There was an irregular, oval scotoma. She had had blurred vision for one year. The macular region was yellow-gray with a faint, underlying arc of pigment in the lower border. There was a large sheet of blood which extended from close to the disc to the macular area above and partly encircled the upper edge where it was thin and bright red. There was an interval between that portion and the lower, almost one disc diameter, where the yellow pink of the fundus was well seen. The great inferior hemorrhage consisted of three parts. At the lower border there was a dark clot nearly the size of the disc in width. Beyond it and temporally, there was a curved band about one-third disc by one disc in diameter, and the background was the bright red of a thin, subretinal hemorrhage.

7. *Choroidal hemorrhage.* Mrs. E. D., aged 79 years, had systolic pressure of 230 mm. Hg. Left eye, vision was 3/200. A large, comma-shaped hemorrhage was beneath the retinal vessels and outlined an irregular, pale macular region, on the surface of which were a few superficial hemorrhages.

8. *Early macular degeneration.* Mrs. S. M., aged 70 years, had had failing vision for two months. A central scotoma was present. Left eye, vision was 5/200. There was an irregular, narrow ring of flat hemorrhages about a grayish, irregular, unevenly surfaced gray macula.

9. *Early macular degeneration.* Dr. F. O'R., aged 68 years, had noticed a month ago that objects were distorted before the right eye. The left eye had been defective for three years. Right eye, vision was 4/200. A disc-diameter, gray, swollen macula was encircled by a narrow rim of blood. Between it and the disc there was a thick, broad hemorrhage.

10. *Choroidal hemorrhage.* Mrs. A. M., aged 66 years, had systolic pressure of 188 mm. Hg. She discovered that the sight of the right eye was poor a month ago. Right eye, vision was 1/200. The temporal half of a two disc-diameter, smoky-gray, slightly elevated macular area was outlined by an irregular circle of granular blood.

11. *Senile macular degeneration, hemorrhage, edema.* W. B., aged 81 years, had systolic pressure of 140 mm. Hg. Right eye, vision was 3/200. A four disc-diameter, macular region was elevated and cloudy. The upper part was the thinner, the prominent lower portion was outlined by an irregular granular hemorrhage.

12. *Choroidal hemorrhage.* Mrs. A. R., 73 years of age, had been unable to read for some months. Right eye, vision was 20/20. There was a broad, flat choroidal hemorrhage in the macula and below.

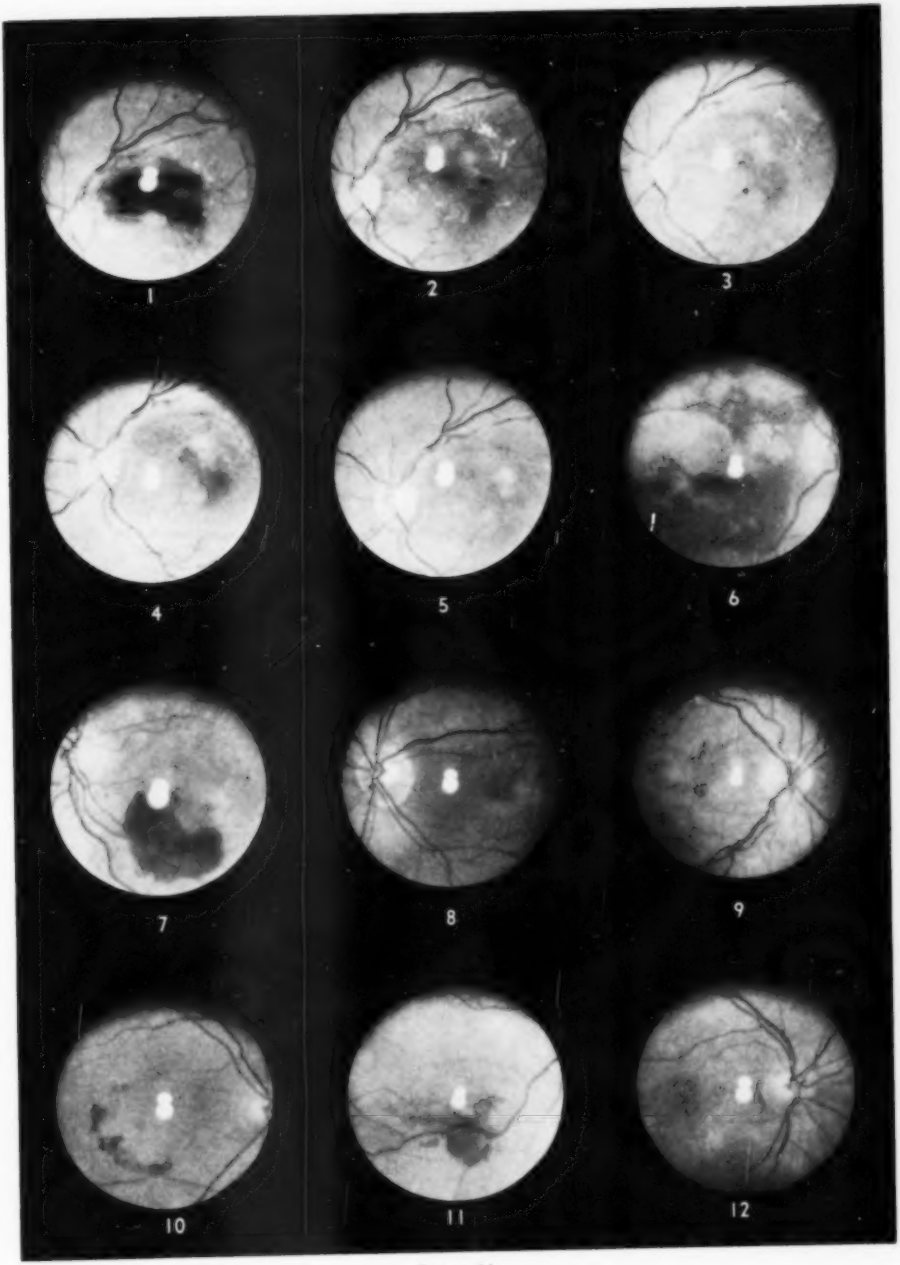

PLATE 11

are much more often associated with senility. Small, crescentic hemorrhages about the macula are frequently the earliest sign of macular choroiditis or retinitis, and as such belong in Group 2. However, they often inaugurate the degenerations.

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PLATE 12 (BEDELL). 1. *Choroidal hemorrhage simulating tumor* (August 7, 1940). When Mrs. E. W. was 78 years of age, she noted that she could not read with her left eye. The general physical examination disclosed no abnormality, except hypertension (blood pressure was 198/106 mm. Hg). Left eye, vision was 6/200 with a 10-degree eccentric, positive scotoma and a temporal field contraction to the 20-degree line. Externally, the eye findings were negative. One small anterior cortical lens opacity extended into the nasal side of the pupillary area, otherwise the media were clear. The disc was large, clearly outlined, and of normal color. The retinal arteries were narrow and the veins normal.

About one disc diameter inferior to the disc was a broad, more than one disc diameter wide by five disc diameters long, dark-gray mass over which the retinal vessels passed without change in course or elevation. This was much wider and darker in the macular region. Overlying and extending about two disc diameters from it to the temporal edge of the disc was a large collection of soft-appearing, yellow-white exudates. Between the inferior margin of the disc and the upper border of the mass there was an ill-defined, slightly raised, lighter, irregular gray swelling.

2 and 3. August 31, 1940. Two photographs were taken. The change in appearance was sufficient to dispel immediately all thought of malignancy. The great tongue-shaped, dark mass was measurably smaller and flatter, the gray swelling was more unevenly pigmented and the exudate was more homogeneous.

4. October 1, 1940. The hemorrhage continued to absorb, leaving a thin gray remnant over which there were several large, flat, yellow exudates. The inferior swelling was more sharply outlined with a gray arc below a dark spot. The exudates were thinner but more widely distributed.

5. November 6, 1940. The eye was turned up so as to get a better view of the site of the hemorrhage and the macula. The dark crescent about the swelling was still greater, the spot in it was a faint pink. Exudates were scattered all over the region of the massive hemorrhage, some were isolated but most of them were closely packed together. Two flat, white spots were in the center of the site of the former hemorrhage.

6. A white, almost flat, one disc-diameter scar was inferior to the disc. Only a few exudates were between it and the pale pink macula. Terminal vision was 20/50.

7. *Senile macular degeneration, choroidal blood* (June 11, 1943). Mrs. D. H., aged 69 years, suddenly lost the vision of her right eye a month before she was first seen. The blood pressure varied from systolic, 220 mm. Hg to 190/88 mm. Hg.

Right eye, vision was 5/100. The upper half of the fundus, including the entire disc, showed negative findings. The macula was slightly gray along the course of the inferior temporal vein where there was a large hemorrhage with a pale center and dark lower edge. There were several pinpoint exudates between it and the disc.

8. March 16, 1944. Vision was 20/100. The macula was darker with a fleck of blood over it. There were several extravasations below, some very faint, others bright red. Almost completely surrounding the very large central area was a broad, white, yellow band of exudate, widest and thickest to the temporal side.

9. January 8, 1945. Many of the former hemorrhages had disappeared and several even larger and redder ones were between the disc and the exudates. The yellow band was broken into more discrete specks.

10. June 3, 1945. Vision was 3/50. The exudates had collected on the outer side and above the dark macular ring with pale center.

11. September 17, 1947. This photograph is reversed. There were no exudates. The macula was a dark, almost black, ring, with some depigmentation between it and the disc. (The patient continued her active life and the vision was 20/200. This reduction was partly due to her cortical cataract which was present at the time of her first visit.)

12. *Senile macular degeneration* (November 6, 1942). Mrs. E. F., aged 64 years, noticed a blur before her left eye, October 23, 1942, and reported for examination November 6, 1942, at which time she had the classical picture of sudden occlusion of the central retinal vein, with vision reduced to 1/200. Physical examination disclosed nothing, except a moderate hypertension. Blood pressure was 170/90 mm. Hg.

On July 2, 1943, the vision was 1/200, the disc was clearly outlined. A half circle of thin, small exudates were spread below the small dark spot of the macula. In the open part of the incomplete exudate ring were a few superficial striate hemorrhages and several nearly homogeneous exudates.

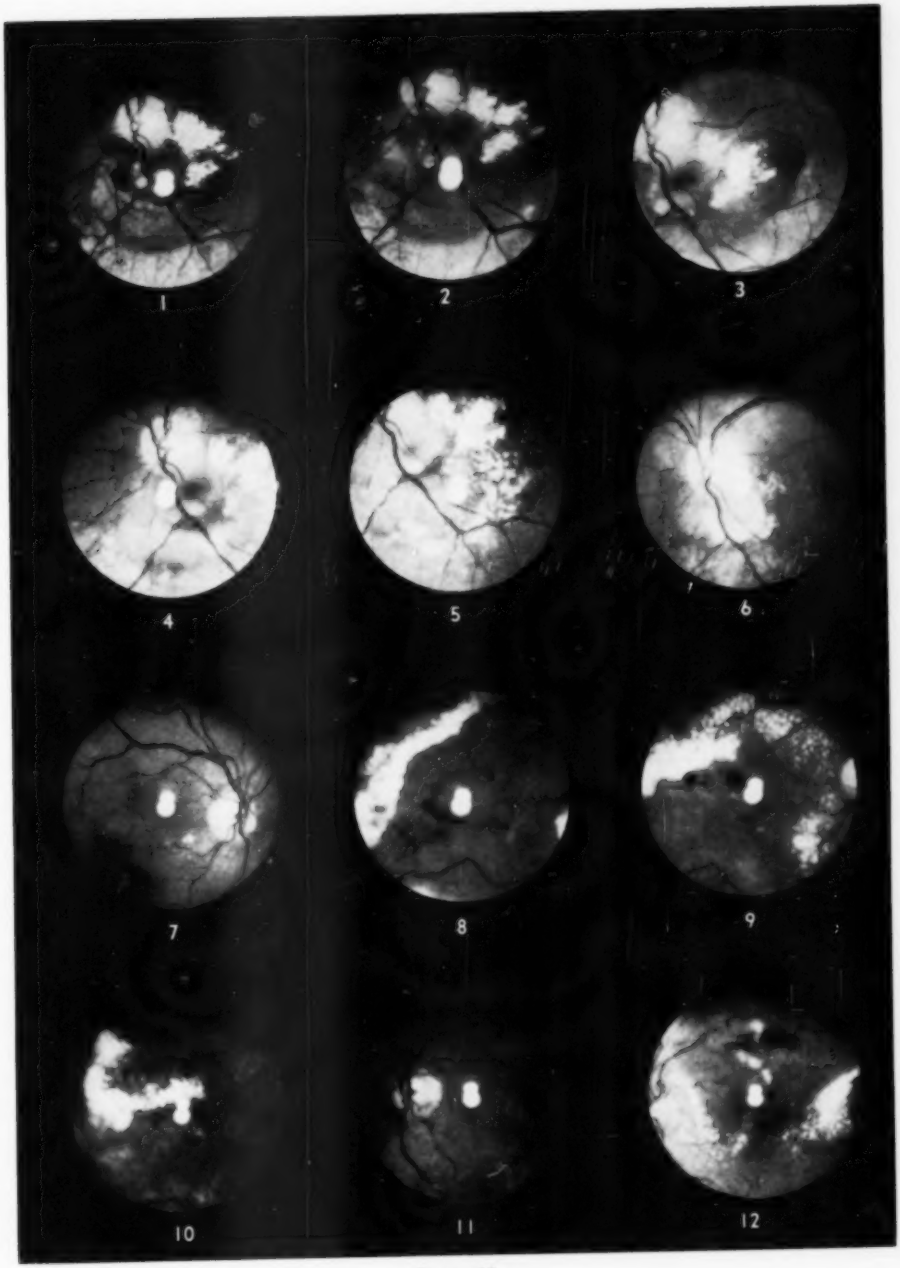

PLATE 12

Senile macular disease may be clinically divided into two separate but interchangeable classes, exudative and degenerative.

In the former there is an increasing, rather steadily elevating, gray, circumscribed macular swelling with a corresponding loss of visual function, decreased central visual acuity, and a central scotoma. The convex surface may be smooth or uneven and the amount of involvement from one disc diameter up to six disc diameters. The elevation may be little or great ranging from a very slight raising to an immense dome.

The color varies from that of gray smoke to a dull white devoid of pigment or blood. A white mass may have a hemorrhage near the center of the surface, a blood border and be with or without pigmentation.

All senile exudations tend to the circular form, sometimes without surface vessels, at other times with a normal retinal circulation or with a marked increase in the retinal and sometimes the choroidal vessels.

It seems probable that the greatest number of senile exudates are gray and disc-shaped, with such considerable variations in shape, size, and degree of elevation that flat gray bands may eventuate.

Another large group of senile changes are the degenerations which pass through the phases already noted in the citations of the appearance at times of primary visit to the

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PLATE 13 (BEDELL). 1. *Senile macular degeneration* (February 27, 1946). S. B., a 52-year-old man, said that he had been unable to read for at least six months. Systolic pressure was 130 mm. Hg. Right eye, vision was 1/200. The macular region was a soft, cloudy gray without a delimiting border. There were a few small hemorrhages and a single, short, black line of pigment. The white choroidal vessels were visible.

2. *Choroidal vessel sclerosis.* Right eye, vision was 1/200. The macular region was a gray, almost white, flat, frayed scar over which the retinal vessels passed. The pigment line was wider and there were a few pigment granules close to the upper edge of the scar which lay over markedly sclerosed choroidal vessels.

3. December 5, 1947. Left eye, vision was 1/200. The choroidal vessels were sclerosed and appeared as white lines. There was a large, white sheet beneath the retinal vessels. This formed an irregular Z, thickest and most pigmented on its lower foot.

4. *Senile macular degeneration, subretinal exudate* (September 23, 1946). H. P. was first seen when he was 63 years of age, with a systolic pressure of 220 mm. Hg. In the right eye, the macular region was swollen and cloudy with an arc of exudate above and many flat hemorrhages. Beneath these changes there was a gray, ill-defined layer which extended beyond the nasal side of the disc.

5. October 21, 1946. The macular region was less swollen. The exudates were in a wider circle and the underlying tissue a well-defined white layer.

6. August 3, 1948. There were several very small hemorrhages about the macula and the exudates had increased in number.

7. *Senile macular degeneration, choroidal hemorrhage* (June 25, 1947). Mrs. G. S. was 74 years of age when she lost her vision. The right eye had been sightless for three years (macular degeneration). The systolic pressure was 186 mm. Hg. Left eye, vision was 2/200. A very large hemorrhage unevenly covered a gray seven disc-diameter area which included the macula. In places the clot was very thick and round; in others, thin.

8. August 6, 1947. The blood had assumed an hour-glass shape over a white base of variable thickness.

9. August 27, 1947. The macula was cloudy gray, raised about three disc diameters, over which the retinal vessels passed. A broad ring of deep hemorrhages encircled it.

10. September 19, 1947. The macular region was an uneven-surfaced horizontal V with the apex toward the disc. Thick hemorrhages were above and below the central scar.

11. May 18, 1949. The central portion of the white, gray, two disc-diameter area was a smoky gray. The retinal vessels passed over the entire region. Vision was 3/200, with a central scotoma.

12. *Senile macular degeneration.* M. D. developed a macular degeneration when he was 70 years of age. Right eye, vision was 20/200. Bright yellow, flat scars of uneven density extended from the temporal side of the disc for almost four mm. They were beneath the retinal vessels and have remained unchanged for years.

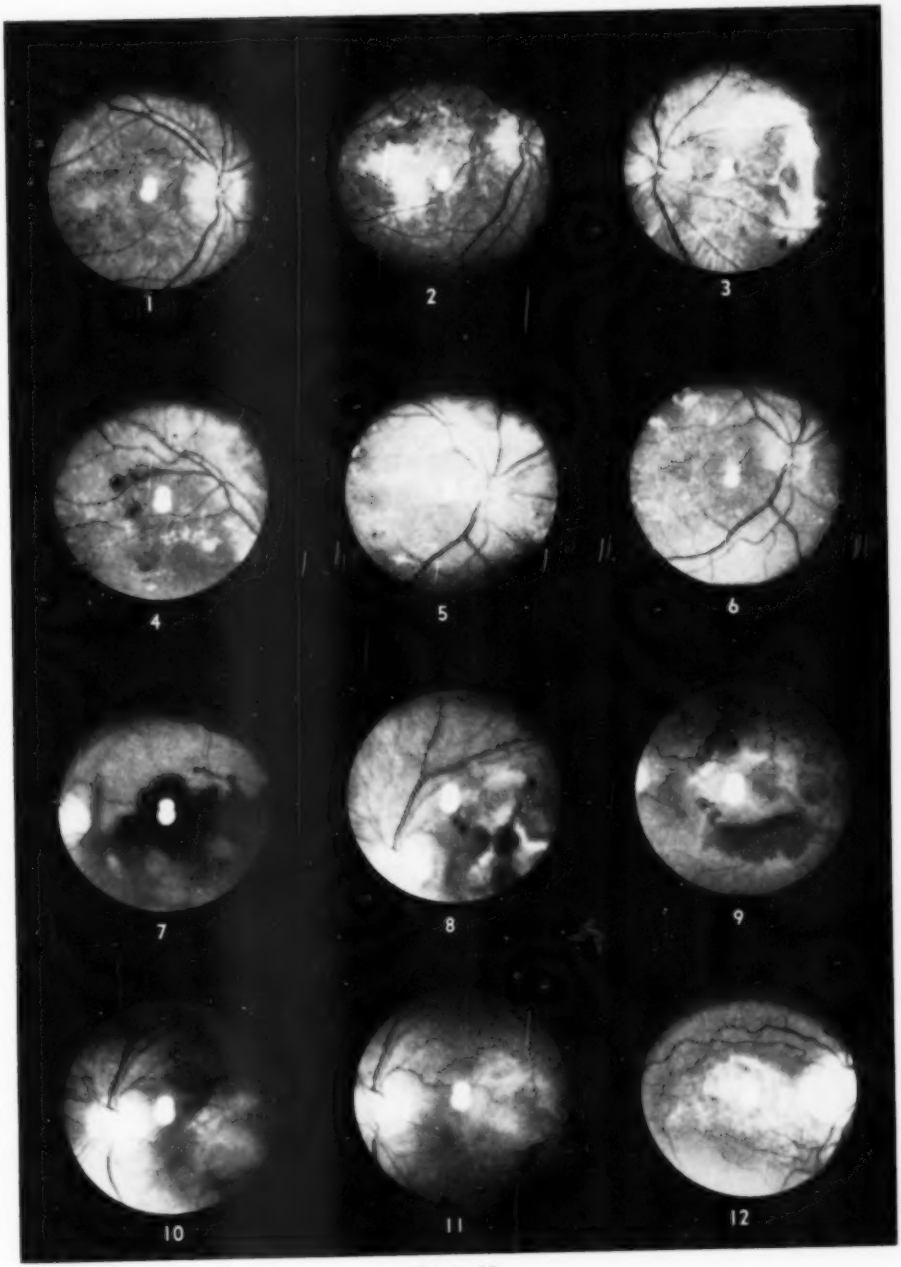

PLATE 13

ophthalmologist. This group is characterized by pigmentations which end in collections of small pigment specks, large deposits or indefinite borders about the scars. There is a wide variety of vascularity. The scars include smoky gray-white sheets, quadrate-gray layers, and irregular ovals. The exudative and degenerative types frequently merge.

The macular area may become so elevated, so infiltrated, and so white or gray that it gives the superficial examiner the impression of an enlarging malignant tumor. In some instances an unfortunate diagnosis has led to the removal of the eye. A careful inspection of the surrounding portions of the fundus and especially the retinal vessels will, in most cases, lead to the postponement of enucleation while awaiting developments. Some of these masses of exudate are domes raised several diopters above the retinal level. They may be only slightly pigmented or the border may be almost black.

When a macular mass is pigmented, there is greater difficulty in excluding a malignant

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PLATE 14 (BEDELL). 1. *Circulatory hole at the macula* (May 26, 1939). Mrs. G. G., aged 68 years, had had a spot before her left eye for three months. Blood pressure was 160/80 mm. Hg. Vision was 20/200. A small, ill-defined, gray area was in the macular region. (Four pictures illustrate the development of a macular hole.)

2. July 14, 1939. The center of the macular region was pink with a very faint, gray ring.

3. November 1, 1939. There was a definite hole in the macula. The crater was shallow with a few white dots on its floor.

4. May 17, 1940. Vision was 10/200. The sharply outlined, round, depressed macular hole had a bright, gray, surrounding ring.

5. *Hole at the macula.* Mrs. A. P., aged 68 years, had vision of 20/200 in the right eye. A typical hole was present in the macula, with a shallow crater, a few dots on the floor, and a gray rim.

6. *Ectatic choroidal scar.* Mrs. S. S. was not seen until she was 75 years of age. Her right eye had always been poor. Vision was 3/200. The disc was clearly defined with a small, shallow central excavation. The vessels on it were negative. A large, pale-brown, more than four disc-diameter area of partially depigmented choroid encircled the macula. The outlining margin varied in depth and width of destruction. Near the center a horizontal oblong almost twice the disc diameter was unevenly fringed with pigment. To the lower temporal side the pigment was densest and extended into an immense, white hole, almost one-fourth the width of the entire scar and more than 12D. deep. Several pigmented streamers were traced for a short distance in the deepest part. Two other pigment lines were in front of a small pigment circle. A dark streak seemed to be the remains of a choroidal vessel. The retinal vessels passed over it.

7. *Macular edema* (December 6, 1944). C. K., a man, aged 59 years, was first examined on December 6, 1944. He gave a history of having worn glasses for 53 years and said the last change was made one year ago. One week before he was examined, he had a "flashing" before his left eye. Left eye, vision was 2/200. A high degree of myopia was present. The macular region was a prominent, rounded, dark mass. There were several peripapillary flecks of hemorrhage.

8. December 11, 1944. An immense localized macular edema over which both the retinal and choroidal vessels were visible.

9. *Cyst of the macula, choroidal hemorrhage* (April 23, 1940). Miss F. R., 51 years of age, had vision of 10/200 in the left eye. A beautifully outlined, horizontal, oval cyst occupied the macular region. There were several exudates and the lower border was formed by a large, red, subretinal, granular hemorrhage. On the edge near the disc there was a similar hemorrhage and also a small dark retinal clot.

10. *Retinochoroidal scar* (July 15, 1942). The vision was 7/200. There was an irregular central scotoma of about seven degrees. A thick, white irregular scar impinged upon the temporal border of the macula and several fainter ones appeared as clouds above and about it.

11. *Preretinal edema.* P. B., aged 29 years, had seen a brown spot the size of a dime before her left eye for two months. She was six months' pregnant (twins). Vision of the left eye was 20/30. (A typical example of preretinal edema with a sharply circumscribed border.)

12. *Retinitis proliferans.* Mrs. M. H., aged 43 years, had vision of 1/200 in the left eye, unimproved with a −9.0D. sph. ⌒ −3.5D. cyl. ax. 180°. Retinitis proliferans covered the macular area, which suggested a large hole because of its striking clearness and the uneven surrounding ring.

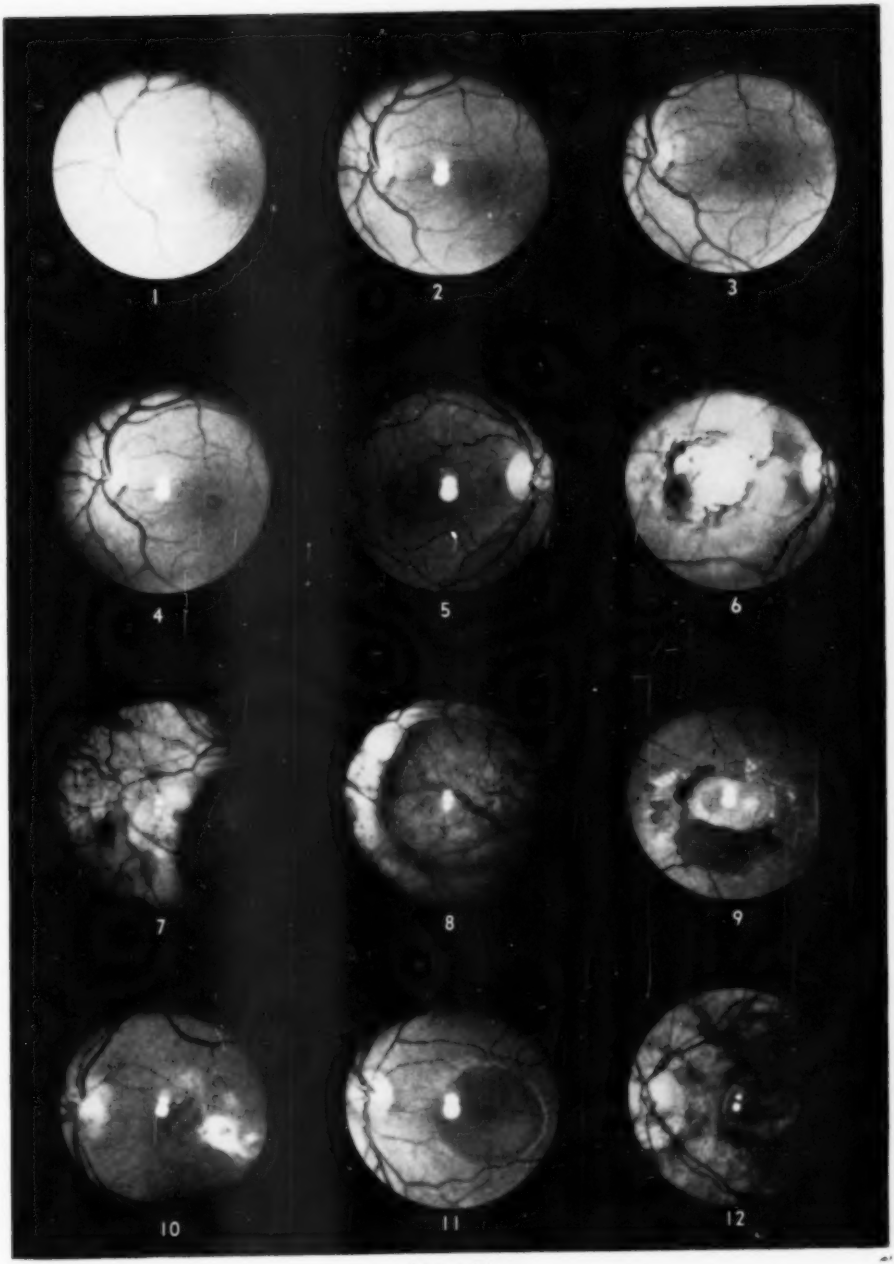

PLATE 14

melanoma, because a white mass may become heavily pigmented without further change in surface or elevation. A malignant melanoma may be so prominent that it calls for immediate enucleation and unwarranted delay may be disastrous.

It is well recognized that carcinoma of the choroid rarely, if ever, becomes an elevated tumor, for it tends to expand rather than to bulge. These are usually pale and only slightly raised and may or may not have small brownish pigmentations. They can usually be distinguished from a choroiditis where there is some cellular infiltration of the vitreous and a soft, yellow, uneven patch.

There is a form of circumscribed macular edema which occurs only in the elderly which needs special consideration, for it leads to a localized destruction of the retina and the formation of a hole in the macula. This starts as a small, roughly one-fourth disc diameter, indefinite, gray macular haze which often escapes detection until there is an elevation of the retinal surface, or even until the cyst ruptures and leaves a frayed margin.

As time passes, the overlying surface disappears and the dark choroid base becomes visible. Still later, when the hole is fully developed, there are several gray or white specks on or close to the rim of the crater and often on the floor. The margin is sharp and not uncommonly surrounded by a broad ring of depigmented choroid. The senile hole is always binocular, although often one eye is involved before the other. Eventually, the holes become about equal in size and depth. Obviously, this cystic dissolution may be seen in any stage of its development and only by understanding its life cycle can an accurate diagnosis be made and a prognosis given.

A curious macular lesion which is a result of generalized retinal vessel arteriosclerosis,

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PLATE 15 (BEDELL). 1. *Macular hemorrhage.* E. P., aged 64 years, suddenly lost the sight of his right eye four weeks ago. Right eye, vision was 3/200. A small, globular hemorrhage was near the macula on a detached retina.

2. *Macular retinochoroiditis.* Mrs. L. J., aged 62 years, had vision of 20/100 in the left eye; with correction, 20/30. A small, yellow ring surrounded the pink center just below the macula.

3. *Retinal cyst.* Miss P. P., aged eight years, had vision of 1/200 in the left eye; with a −11.0D. sph., 1/200. A small cyst was near the macula.

4. *Retinal cyst.* Mrs. M. A., 73 years of age, had vision of 5/200 in the right eye. She had had hypertension for three years. Systolic pressure was 186 mm. Hg. There were faint cataractous changes. There was an elevated, muddy-gray, three disc-diameter, sharply outlined cystic mass in the macular region.

5. *Circumscribed subretinal exudate.* A 19-year-old boy, W. D., showed vision of 20/20 in the right eye. There was a 2.5 disc-diameter, elevated, gray, almost circular mass extending from the macula downward, with a central scotoma.

6. *Choroid scar.* A. H., aged 73 years, had vision of 20/70 in the right eye. A circumscribed, yellow-white scar was present in the macular region of the right eye. A choroidal vessel was visible on the floor.

7. *Macular retinitis.* C. R., aged 37 years, had vision of 20/100 in the right eye. There had been a black spot in front of his right eye three weeks. He showed a small, irregular, 10-degree field. There was an oval, gray, 0.75 disc-diameter, slight elevation in the macular region. The center was of normal color.

8. *Fold in the retina.* A. M., aged 67 years, had vision of 20/70 in the right eye; with correction, 20/20. Systolic pressure was 155 mm. Hg. There were several, light-colored folds in the retina to the temporal side of the macula.

9 and 10. *Angioid streaks, macular degeneration* (September 16, 1946). Mrs. M. V., 29 years of age, had vision of 20/50 in the left eye. A one disc-diameter, gray area developed an irregular hemorrhagic margin. (These photographs show the changes which took place as the angioid streaks increased in size and the macula lost its normal color.)

11. October 11, 1947. The third photograph shows the well-developed macular scar with a decrease in the hemorrhage and a very decided increase in the width of the superior temporal streak.

12. October 11, 1947. Right eye, vision was 20/50. The angioid streaks were very wide, well marked and, in the macular region, there was a linear white scar.

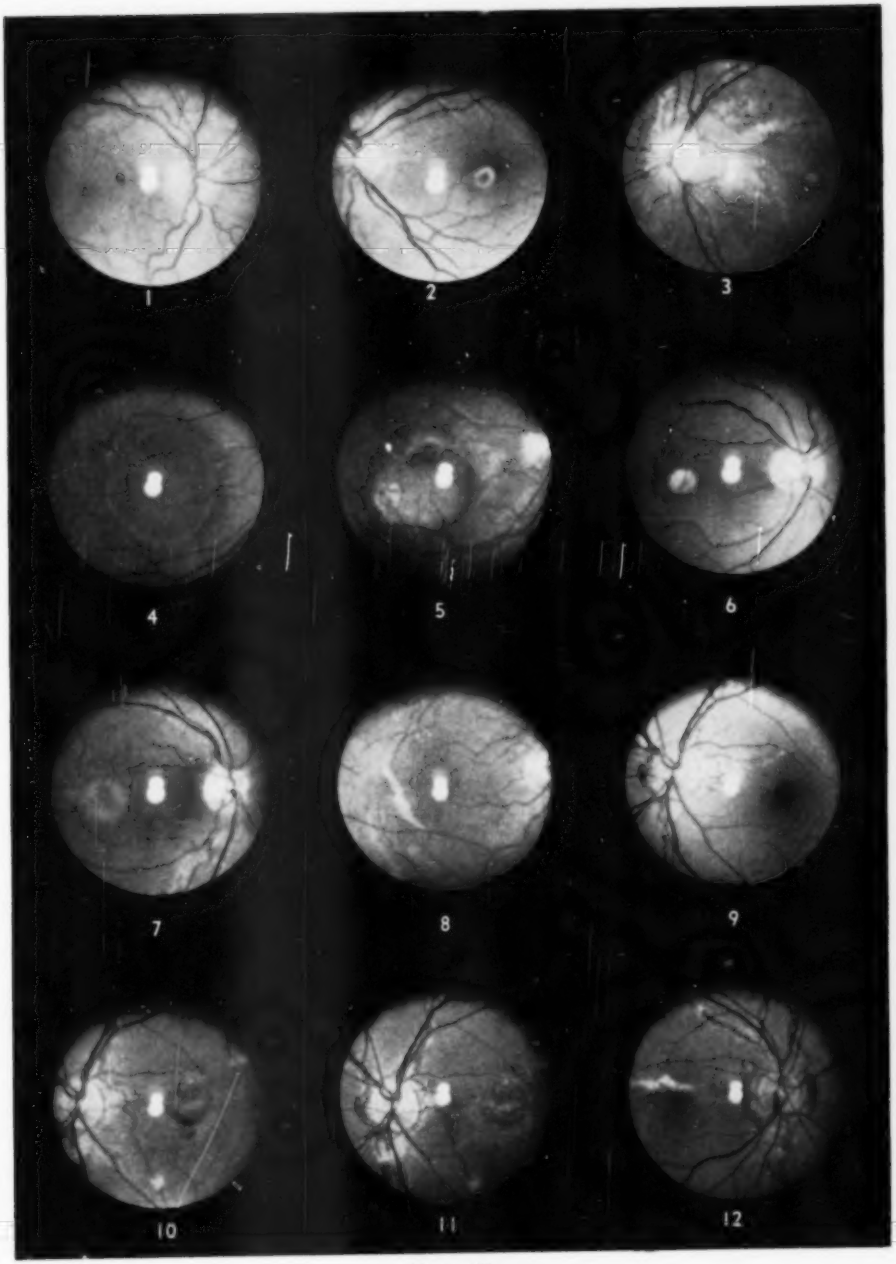

PLATE 15

usually of mild degree and not accompanied by retinal hemorrhages, is a thin, golden-yellow, delicate, veil-like layer which gradually merges into the adjacent, unaffected retina. It causes a reduction in vision. Sometimes the film is so thick that it appears like a yellow fleece. Both forms usually persist unchanged.

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PLATE 16 (BEDELL). 1. *Retinal exudate.* Miss L. R. was 33 years of age when her left eye showed vision of 20/200. The disc was pale, the superior temporal vein tortuous. A golden veil of small openings covered the region between the disc and the outer macular rim. The eye had been extremely divergent since birth.

2. *Retinal exudate, arteriosclerosis.* N. DeC., a woman, aged 52 years, had a systolic pressure of 150 mm. Hg and diabetes. Left eye, vision was 20/40. The disc was clearly outlined. The artery reflex was accentuated and where it crossed the vein there was a slight indentation. A film of very small, bright dots covered the macula and extended downward.

3. *Senile macular degeneration.* Mrs. S. P., a 69-year-old woman, showed a fundus which was so disorganized that it was a surprise to know that she had 20/30 vision. The systolic pressure was 162 mm. Hg. The upper margin of a six disc-diameter, central area was a broad band of exudate below which there was a flat ribbon of blood. The entire region was grossly depigmented with several small hemorrhages and irregular pigment spots.

4. *Diabetic retinopathy.* The changes which take place in the macular region in glycosuria are well illustrated by the widespread, soft yellow, large exudates and round, 0.60 disc-diameter area over the center of the macular region in P. C., a 47-year-old man who had had diabetes for 10 years. The vision in the left eye was 20/200. The right eye was similar.

5. *Retinochoroiditis.* Often a thin, elevated, circumscribed mass in the macula is sufficiently large to arouse the suspicion of a malignant growth. Mrs. E. O., a 53-year-old woman, was greatly upset because enucleation had been advised. The irregularly circumscribed, pigmented, white mound in the macular region was on a pale base. Neither the ovoid central scotoma nor the scar has changed in 10 years.

6. *Senile macular degeneration.* W. B., a 53-year-old railroad man, claimed that, as a result of a recent trivial head blow, he had lost his sight. Right eye, vision was 1/200, with a 10-degree central scotoma. A three disc-diameter, pale, almost round, macular area was overlaid with heavy, almost black, widely scattered and variably sized plaques. The upper, outer side of the center was a white, flat scar.

7. *Senile macular degeneration.* Left eye, vision was 2/200. There was a white, flat, quadrate scar about 3.0 by 5.0 disc diameters. In places, the margin was sharp and clear-cut and in other portions, especially above, it was so thin that the edge was not defined. The retinal vessels were unusually clear and distinct over the entire scar which had a wrinkled cellophanelike reflecting surface.

8. *Senile macular degeneration.* When Mrs. H. C. was 60 years of age, she had a systolic pressure of 110 mm. Hg and had had a nose operation the year before. She further said that she had what was diagnosed as a hemorrhage in the eye three years ago. Left eye, vision was 20/200. The macular region was a white, thick oval with specks of pigment on its surface.

9. *Senile macular degeneration.* Mrs. S. B., a 67-year-old woman, in "good" general health had 3/200 vision in her right eye and 10/200 in the left. The right eye showed a yellow-white, round mass of about three disc diameters. The thick, disc-sized center was surrounded by a dark, less infiltrated ring beyond which there was another flatter band.

10. *Disciform degeneration of the macula, exudative.* Miss J. F. S. was 68 years of age when her right-eye vision was 1/400 and her left, 3/70. The disease was binocular. For two years she had been treating for high blood pressure (276 mm. Hg, systolic). In the macular region of the right eye was a large, prominent, dome-shaped, white tumor, projecting for several diopters. The margin was well defined, the retinal vessels coursed over it. There was one small pigment spot on the tumor's lower edge and a larger one near the upper. Between it and the disc there was a flat, red hemorrhage and several exudates.

11. *Disciform degeneration of the macula, exudative.* When Dr. A. S., aged 82 years, came to the office, she was greatly distressed because she had inferred from her attendant that she had a malignant growth in each eye. The left-eye vision was 1/200 with a 10-degree, round, central scotoma. The pale, yellow, dome-shaped, three disc-diameter macular area was well defined with pigmentation on and between it and the disc. The surface was not nodular and the retinal vessels passed over it.

12. *Disciform degeneration of the macula.* A somewhat similar exudate was in the left eye of W. P., 77 years of age. The vision of the left eye had been failing for seven years. The right eye was not involved. Left eye, vision was light perception, with a 15-degree central scotoma. There was a five disc-diameter, pale, yellow, circumscribed mound, with several pigment collections and one small dot of blood on its surface.

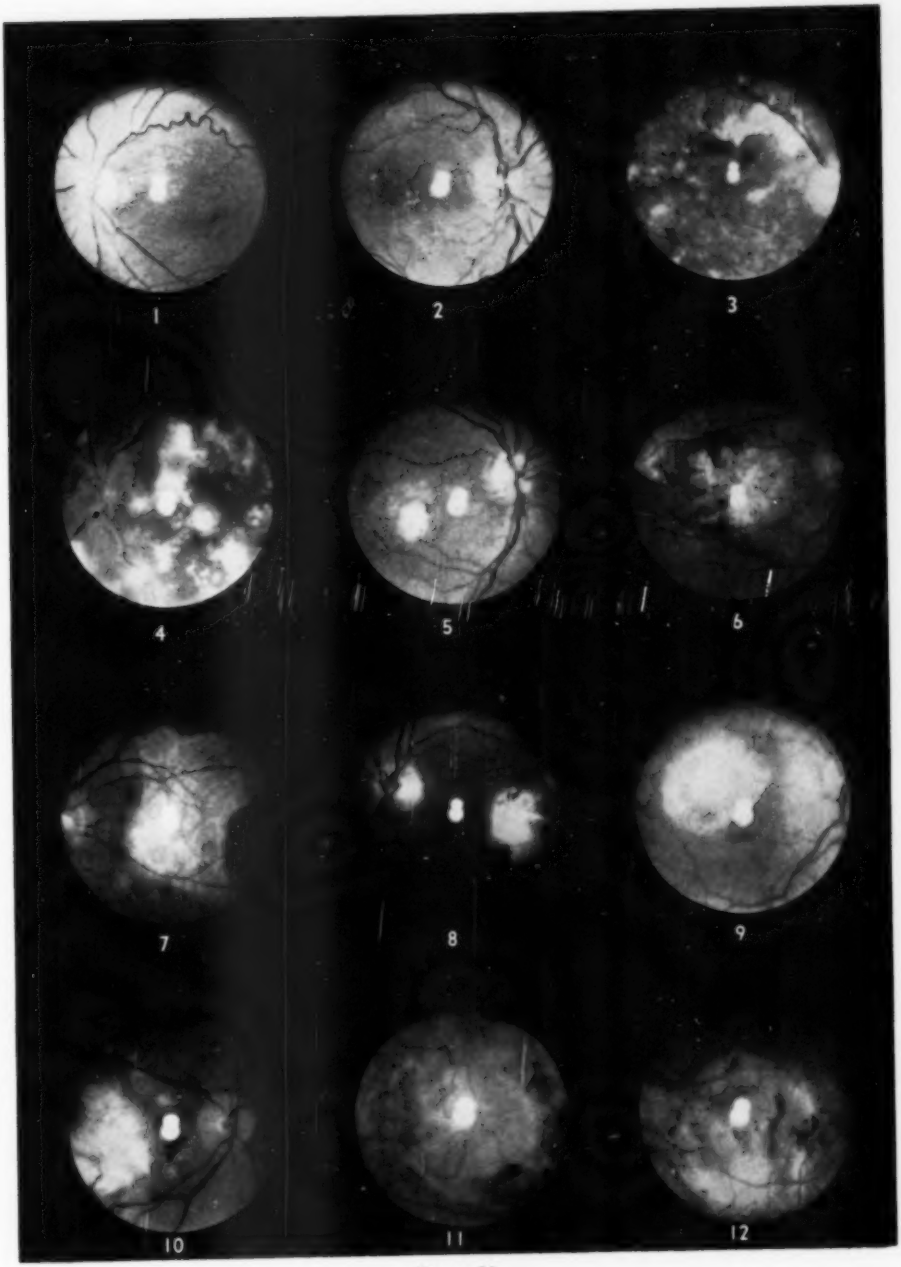

PLATE 16

In contrast to the delicate layers, there are well-defined, smooth-surfaced cysts. The appearance of a cyst and the early stage of the macular hole may resemble a localized retinitis, where the retina is gray, the margins soft, and the elevation slight. After healing has taken place, there is a well-delineated absence of the retina, choroid, or both, with vessels on it.

Occasionally, retinitis-proliferans bands may encircle the macula leaving a round, clear portion of the membrane which gives the impression of a gray retina with a loss of retinal tissue. The pseudohole, a window in the sheet, is easily recognized on stereoscopic examination or the skillful use of parallax.

Summary

The macular diseases are segregated into three groups:

1. Those which may develop at any time from birth to death and, although seen in advanced age, are not the result of senescence.
2. Those found most often in the old but which may appear in the young.
3. Those present only in the elderly.

The healthy macular region is variable in color, size, and conformation.

The ideal way to appreciate the course of macular disease in the elderly is to study and photograph individual cases in order to recognize and evaluate every change from the earliest onset of foggy vision to the terminal scar. The rate of progress, the degree of destruction, and the terminal scar are inconstant.

Usually both eyes are involved in senile macular disease.

Allusion has been made to the common sources of confusions and errors in diagnosis.

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Plate 17 (Bedell). 1. *Senile macular degeneration, exudative* (January 2, 1937). Mrs. L. H., aged 64 years, had systolic pressure of 200 mm. Hg. Recently she had noted poor sight. Right eye, vision was 6/200, with a dark, gray, edematous macular region with small surface hemorrhages.

2. October 30, 1939. There was a four disc-diameter, soft, elevated, yellow infiltration of the macular region.

3. October 15, 1943. Sclerosed choroid vessels were the background for a large, soft, gray, white mass near the center of which the macula was very dark with some superficial vessels.

4. *Senile macular degeneration, exudative* (February 6, 1945). Mrs. C. P. W., aged 73 years, had systolic pressure of 184 mm. Hg. Vision had been failing for several months. Left eye, vision was 4/70. A three disc-diameter macular area was elevated, gray, and speckled with blood. A partial crown of lacelike exudates encircled it.

5. May 10, 1945. The exudate crown was greatest between the macula and the disc. The macular area was more swollen with several small hemorrhages.

6. March 14, 1946. The macular area was much flatter but still of uneven surface, with an indefinite ring of soft gray exudates.

7. April 23, 1947. There was a marked shrinking of the entire macular region which was almost flat and indefinitely outlined by early sclerosis of the choroid vessels.

8. November 15, 1948. The whole region was much flatter. The scar was more silvery with several flecks of pigment.

9. November 15, 1948. Right eye, vision was 5/200. There was a four disc-diameter, soft, yellow, ill-defined macular swelling with irregular pigmentation over sclerosed choroidal vessels.

10. April 23, 1947. Right eye, vision was 3/200. The three disc-diameter, irregularly depigmented, yellowish raised circular macular area had a double ring of hemorrhage above it.

11. *Retinal detachment.* Mrs. J. S., aged 72 years, had a high degree of myopic astigmatism. Left eye, vision was 1/200. A large, smooth, elevated area extended from the border of the disc outward for about seven disc diameters. The retinal vessels passed over it. The fluid was translucent.

12. *Disciform degeneration of the macula, exudative.* F. H., aged 78 years, had vision of 1/200. The right eye had been blurred for 10 months. There was a large central scotoma of about 20 degrees. The disc was clearly and sharply outlined. The arteries and veins were of normal size. Starting about 0.75 disc diameters to the temporal side of the disc was a 5.5 disc-diameter white dome over which the vessels passed. Near its apex was one small hemorrhage.

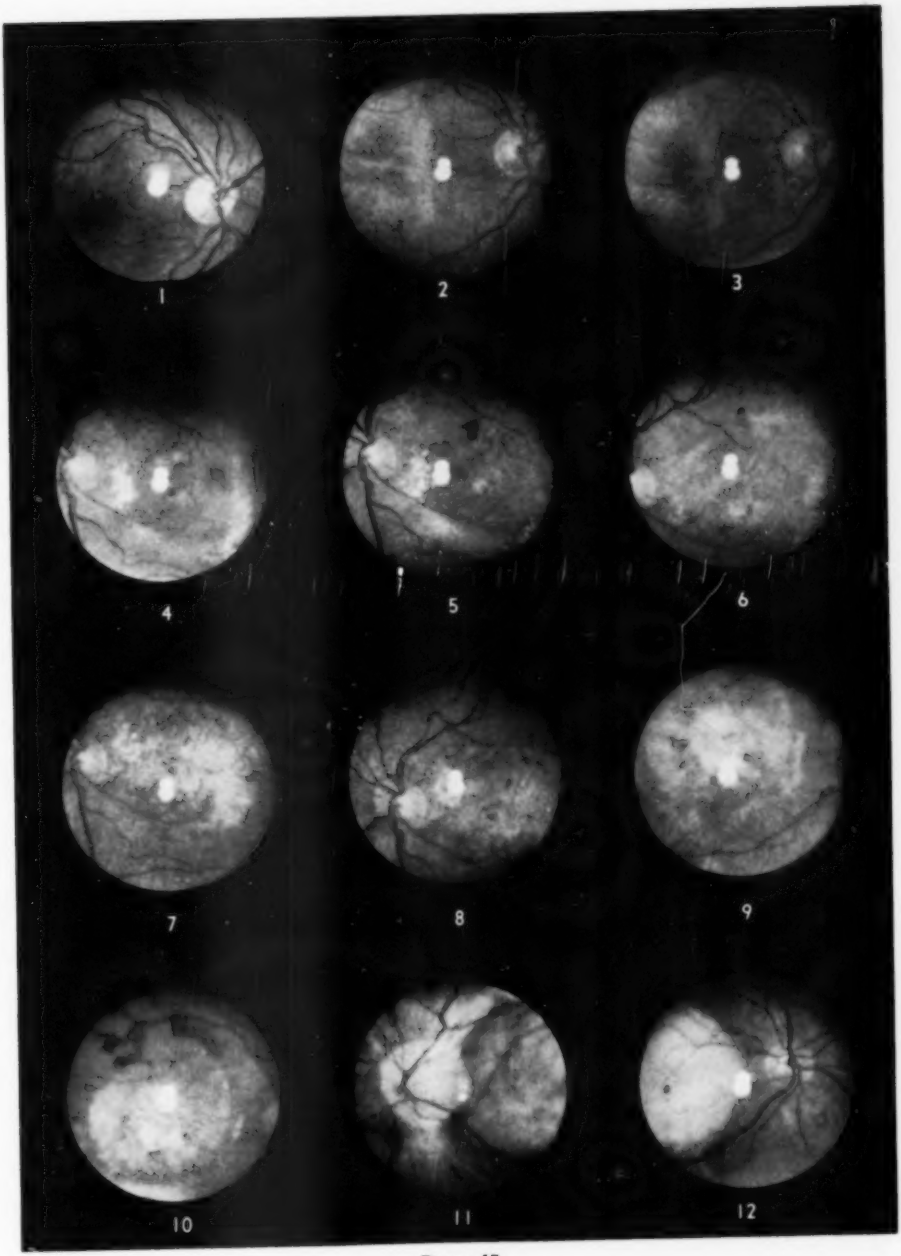

PLATE 17

A thorough understanding of the material will tend to conserve the eyeball and prevent unnecessary enucleations.

Perusal of the text and the pictures makes it possible to visualize most of the macular changes in the elderly. The illustrations are arranged to stimulate interest and invite careful scrutiny.

In the appraisal of macular lesions it is recognized that the tissue age may be very different than the chronological age. This is well known and needs no amplification.

Retinitis circinata is not a clinical entity. The term disciform degeneration of the macula should be restricted to the round lesions.

Three hundred and thirty-six photographs, originally presented in Kodachrome, are reproduced in black and white.

The literature is so voluminous and has been so well reviewed that no references are appended.

Finally, every patient with senile macular degeneration should be told that he will never become blind as a result of the disease.

344 State Street.

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PLATE 18 (BEDELL). 1. *Senile macular degeneration, early stage* (March 24, 1942). W. B. W., aged 63 years, was first seen one year after the sight of the right eye had failed. The blood pressure was 122/65 mm. Hg. Right eye, vision was 20/100 with a 10-degree central scotoma. A 2.5 disc-diameter, smoky-gray area included the red macula.

2. April 7, 1942. The macular area was more defined, the macula itself was redder with a cap of deep blood and many pinpoint exudates.

3. May 6, 1942. The exudates were less distinct for they were in front of two rings of granular blood covering 1.25 disc diameters, arranged as an encircling oval. A few flecks of blood were present.

4. May 26, 1942. The hemorrhagic circle was separated into isolated clots. The macula was darker and the exudates fewer. Some fresh hemorrhages were below the macula.

5. *Retinopathy of chronic nephritis* (July 1, 1938). When T. G. was 35 years of age, the vision of his right eye became blurred and it was found that he had a chronic nephritis with a systolic pressure of 240 mm. Hg. The vision was 20/200. The macular region and a wide area surrounding it were edematous with several isolated flecks of solid-appearing, yellow edema.

6. *Macular star* (August 29, 1938). After an attack of coma which lasted several hours, the macular region showed a typical stellate figure with many fine exudates between it and the disc. The arteries were narrow and in places showed spastic contractions. The patient died six weeks later.

7. *Drusen, senile macular degeneration.* Miss E. V., aged 64 years, had systolic pressure of 212 mm. Hg. Left eye, vision was 20/30. Scattered throughout the posterior pole were many small, bright, light-reflecting dots beneath the retinal vessels. In and about the macular area there were several larger ones and directly over the macula there was a soft, gray, ill-defined cloud.

8. *Benign melanoma.* Mrs. M. J. S., aged 70 years, was under treatment for hypertension when in the routine examination a slate-gray, flat area was found impinging upon the macula. The retinal vessels passed over it. Vision was 20/20.

9. *Malignant melanoma of the choroid.* F. H. was 30 years of age when he noticed a dimness of the sight in his left eye. The vision was 20/30 and he had a large temporal scotoma. The dark mass in the upper quadrant, with a gray overlying retina, extended over the macula with a thin rim of blood. To the nasal side of the disc there was a flat hemorrhage.

10. *Malignant melanoma of the choroid.* Mrs. M. M. was 59 years of age when she reported that five days ago she noticed a cloud before her left eye. The vision was 3/200. The only retained field of vision was a small area to the lower temporal quadrant. A great bulging, smooth-surfaced tumor was so large and projected so far forward that its surface could not be focussed at the same time as the disc.

11. *Malignant melanoma of the choroid.* W. R. B., aged 49 years, reported that something was interfering with the sight of his right eye. The vision was 20/70, with a very large scotoma corresponding to the position of the tumor. There was a large, prominent, dark mass with a wrinkled surface projecting far forward. There were a few hemorrhages near the lower margin and the retinal vessels were on the mass.

12. *Metastatic carcinoma of the choroid.* Mrs. L. C. had a metastatic carcinoma of her choroid. (This has been reported in the *Archives of Ophthalmology*, volume 30, page 25, July, 1943.) This photograph shows the characteristic lesion which is a pale, flat, slightly elevated tumor with many brown flecks of pigmentation.

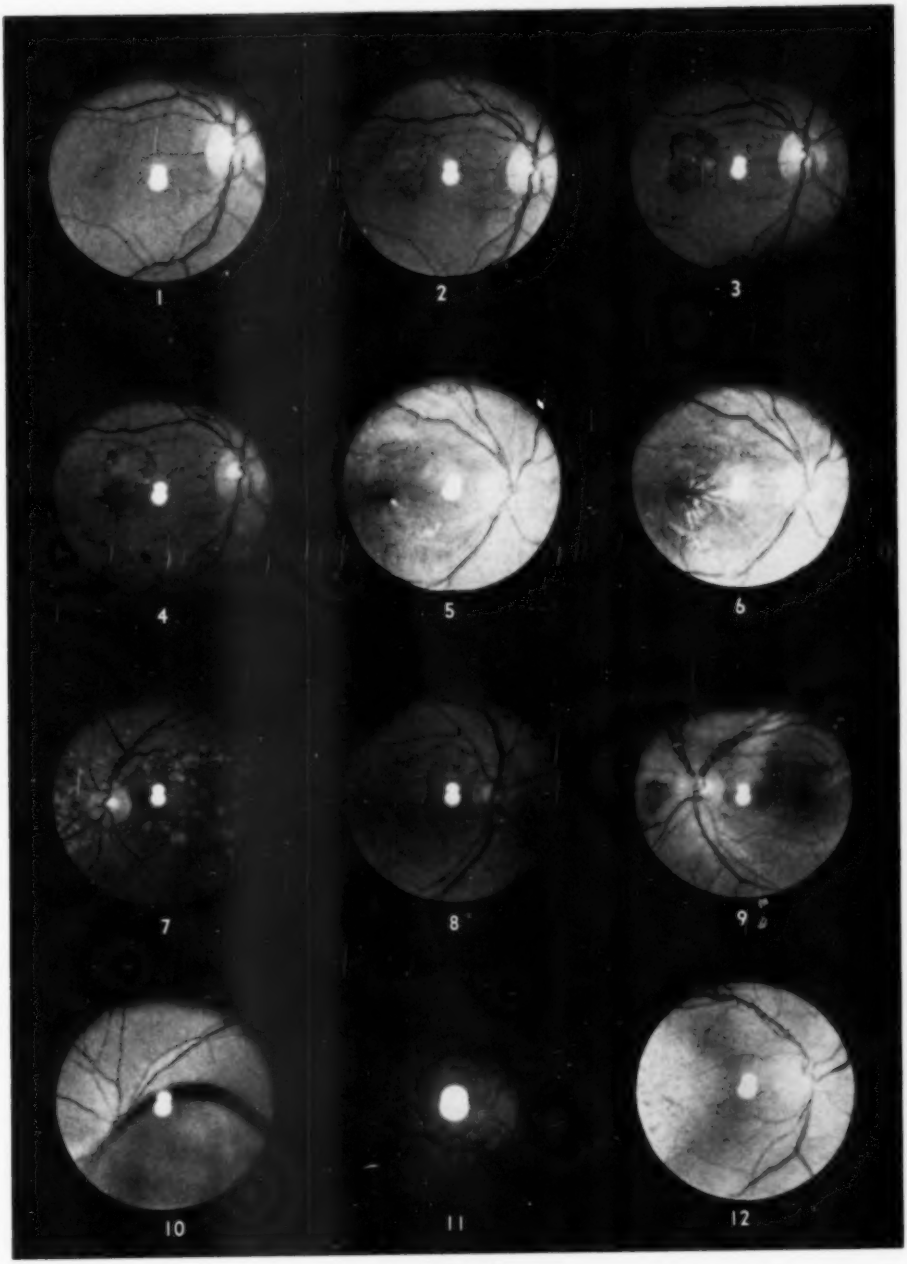

PLATE 18

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PLATE 19 (BEDELL). 1. *Diabetic retinopathy.* Miss E. V. A., aged 64 years, had had diabetes six years before the vision of the right eye failed. The blood sugar was 157 mg. percent. Blood pressure was 180/110 mm. Hg. Right eye, vision was 5/200. Throughout there was a wide, five disc-diameter circle; near the center were many soft-gray spots. The macula was pale with an irregular oblong of pigment over it.

2. *Senile macular degeneration.* E. T., a 65-year-old clergyman, lost the vision of his right eye about six months before this photograph was taken. He was taking digitalis for a heart condition. Right eye, vision was 1/200 with a very large, three disc-diameter, macular degeneration and a densely pigmented overlying sheet.

3. *Senile macular degeneration.* W. D. was 79 years of age when he had vision in the right eye of 2/200. A large circle of irregular, partial depigmentation included the pale macular center with one visible choroidal vessel. There were several flecks of pigment over a two disc-diameter area.

4. *Retinochoroiditis.* V. M., a 30-year-old woman, had dense, dark brown spots over a partially depigmented base and two small macular hemorrhages. Left eye, vision was 20/70. The field was less than 10 degrees.

5. Right eye, vision was 5/200 with a horizontal pigment band on the upper margin of a small macular scar. There was widespread choroidal destruction similar to that in the left eye.

6. *Senile macular degeneration.* Mrs. A. H. was 70 years of age. For at least five years her sight had been defective. Blood pressure was 140/80 mm. Hg. Left eye, vision was 3/200. In the macula was a very large, pale, yellow scar with a central black ring of one-third disc diameter. The temporal margin of the large area was heavily pigmented.

7. *Malignant melanoma of the choroid.* I. L., a 43-year-old woman, recently noted a loss of sight in her left eye. The vision was 20/200. The macular region was occupied by a large, round, elevated, very dark tumor, with an irregular border and several light-colored spots. The field of vision was limited to the inferior temporal quadrant.

8. *Senile macular degeneration* (June 9, 1941). When A. R. was aged 61 years, a blur came before his left eye. He was said to have been cured of diabetes and showed no excess of blood sugar. The vision was 20/20. A broad, long, pale, gray retinal band was to the outer side of the macula with a double line of increased density.

9. *Intense pigmentation* (December 31, 1943). The white band was contracted to a wide arc outlining the disc side of a very dark, almost black, rounded mass. Not malignant.

10. *Senile macular degeneration.* Mrs. H. O., a 70-year-old woman had blood pressure of 172 mm. Hg. This was a case which called for careful investigation and rather prolonged observation before the diagnosis was made with comparative certainty. Left eye, vision was 8/200. A dark mass extended from close to the temporal border of the disc and fanned outward beyond the macula. In parts the pigment was very dense, almost black. The macular region, about two disc diameters, was soft and gray with a few fine hemorrhages on its superior, temporal margin. Neither the mass nor the central scotoma has changed in the past year.

11. *Senile macular degeneration.* Mrs. A. H., the same patient as shown in Figure 6, had vision of 3/200 in the right eye. She showed extensive involvement of the macula and the regions about it. The base was elevated and pale. In the upper portions, there were two brilliant spots. Inferiorly, there were pigmented plaques, while more inferiorly there was a large, lighter swelling. The retinal vessels passed over the lesions.

12. *Macular degeneration in a myope.* K. Z. was aged 60 years when first seen. The blood pressure was 204/120 mm. Hg and the blood sugar 115 mg. percent. The vision of the right eye was 20/200, unimproved with a −8.5D. sph. ⊃ −4.5D. cyl. ax. 75°. The macular region was a dark spot with an oval hemorrhage below.

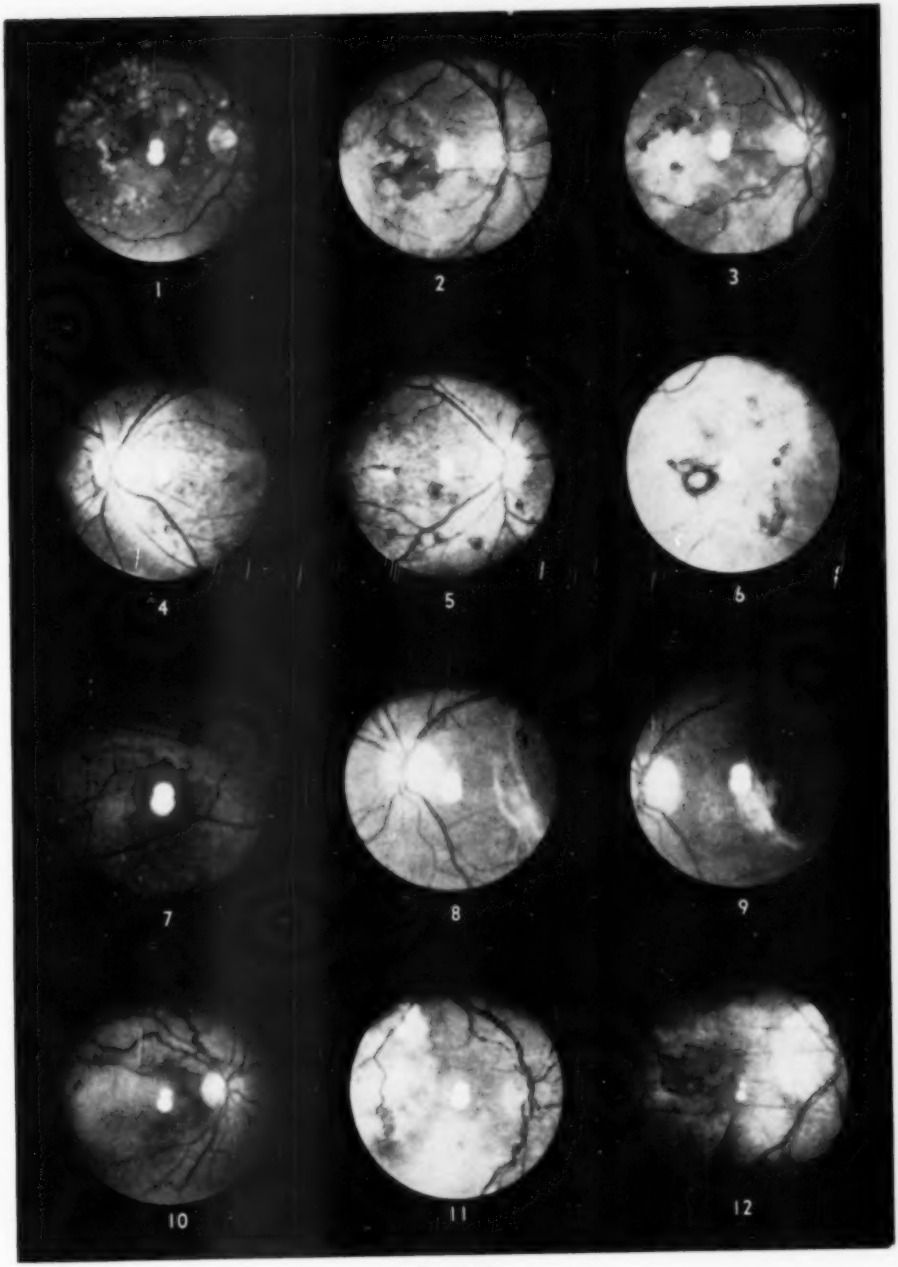

PLATE 19

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PLATE 20 (BEDELL). 1. *Choroidal vessel sclerosis.* (An excellent example of localized choroidal vessel sclerosis with disappearance of the overlying pigment layer.)

R. F., aged 72 years, complained of failing sight for the past two and one-half years. Physical examination was negative. The systolic pressure was 140 mm. Hg. Right eye, vision was 20/20. The fundus was normal except for a 0.5 disc-diameter, irregular macular area of choroidal vessel sclerosis and several smaller places.

2. Left eye, vision was 20/100. There was a central scotoma of 15 degrees. The choroidal vessel sclerosis was more marked. There were two disc diameters of macular destruction, with flecks of pigment near the lower edge.

3. *Choroidal vessel sclerosis* (January 6, 1940). Mrs. L. G., aged 74 years, was under observation for several years during which time the sclerosis of the choroidal vessels in and about the macular region advanced to such an extent that at the end of four years the lesion was more than twice its former size. (The three photographs (3, 4, and 5) illustrate the method of progression as the blood pressure rose from 194 to 230 mm. Hg.)

Right eye, vision was 10/200. When first seen, the macular region was a well-circumscribed, three disc-diameter, pale oval with specks of pigment on the slightly depressed floor.

4. April 21, 1942. Right eye, vision was 3/200. The area of sclerosed choroidal vessels was almost twice as large.

5. May 3, 1945. Vision was 2/200. The diseased region was more than five disc diameters and so large that all of it cannot be seen in a single photograph. An absolute central scotoma reflected the size of sclerosis. The left eye was similarly affected.

6. *Choroidal vessel sclerosis* (May 22, 1947). Another example of bilateral choroidal vessel sclerosis was the case of Mrs. L. O., aged 74 years, with systolic pressure of 176 mm. Hg. Right eye, vision was 5/200. There was a four disc-diameter, central area of irregular sclerosis of the choroidal vessels with variable white walls and retinal pigment deposits.

7. October 20, 1947. Right eye, vision was 20/200. The scotoma was larger. The region of sclerosis had increased to a long, vertical oblong. The margin between the healthy and diseased vessel was clear.

8. *Retinal detachment, choroidal vessel sclerosis.* Miss I. D., aged 71 years, had a spontaneous detachment of the retina in the right eye. The left eye has remained unchanged for 24 years, the period of my observation. Left eye, vision was 1/200, with a complete loss of the upper half of the field of vision. The lower half of fundus showed an advanced grade of sclerosis of the choroidal vessels as tangled white lines and sharply outlined borders with fine pigmented plaques. The retinal vessels were narrow and they clearly traced over the pale disc.

9. *Choroidal vessel sclerosis.* M. L. C., a 60-year-old man, had bilateral choroidal vessel sclerosis. Left eye, vision was 5/200. The large, 4.0 by 5.0 disc-diameter, central region showed the retinal vessels crossing over the white walled scleral vessels.

10. *Choroidal vessel sclerosis.* J. G., a 65-year-old man, had bilateral choroidal vessel sclerosis. In the left eye, the disc was pale, the arteries were small, and the veins slightly reduced in caliber. The retinal and choroidal pigment was collected into a few black flakes. The sclerosis was greatest in the anterior layers of the choroid over the deeper and larger, less-involved vessels.

11. *Macular retinochoroiditis.* Mrs. H. T. was 32 years of age when she showed a large macular scar of retinochoroiditis with a well-marked sclerosis of the choroidal vessels and widely distributed pigment on the floor. Right eye, vision was 4/200, with an 18-degree central scotoma and contracted visual field. Her left eye was normal.

12. *Choroidal vessel sclerosis.* B. B., a 52-year-old man, had bilateral macular region choroidal vessel sclerosis. The right eye showed the white scleral base, the very large choroidal vessels, and pigment flakes.

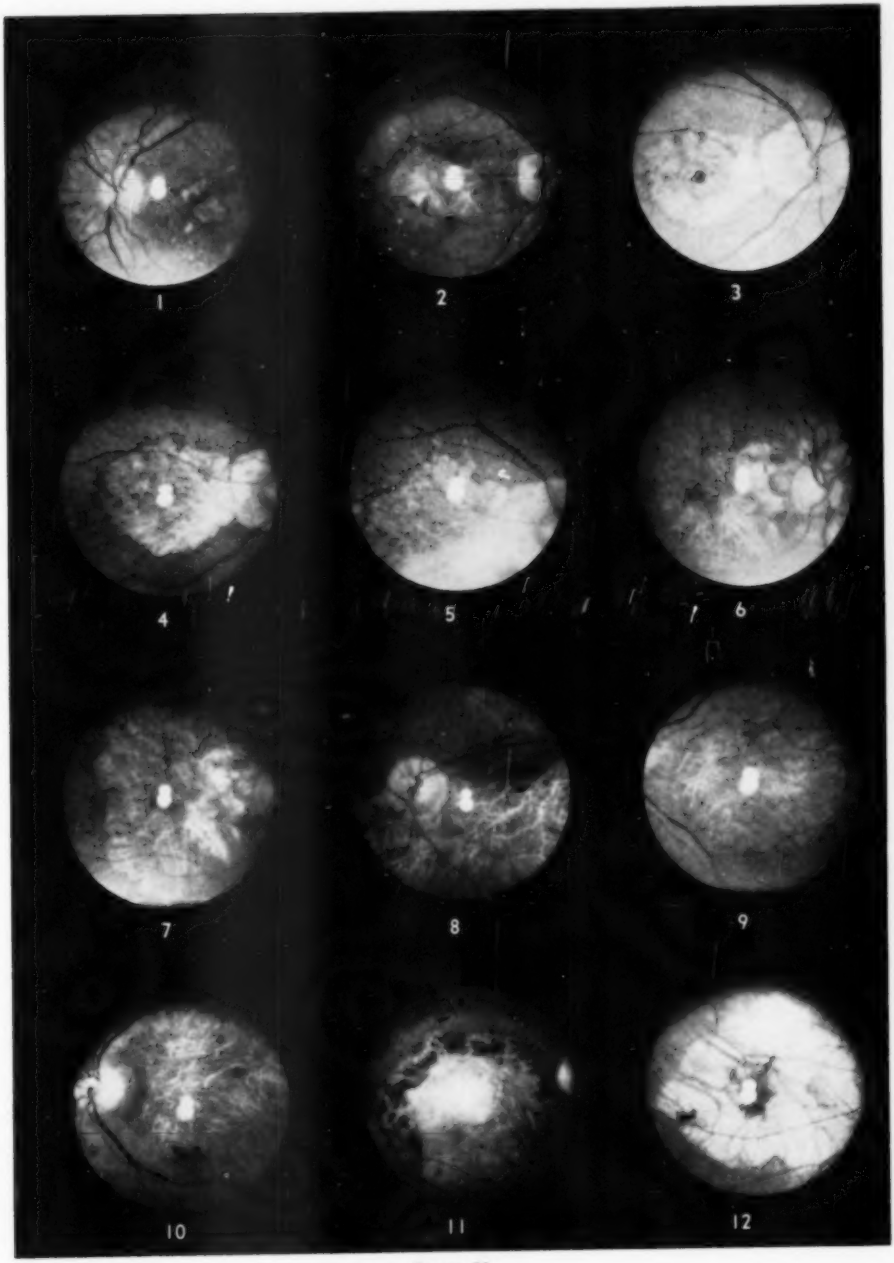

PLATE 20

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PLATE 21 (BEDELL). 1. *Senile macular degeneration* (February 20, 1941). J. K., aged 73 years, had systolic pressure of 160 mm. Hg. Right eye, vision was 5/200. There were several small, lacelike spots of exudate to the temporal side of a four disc-diameter pale, elevated, macular area with a few streak hemorrhages on the border of what appeared to be a cyst.

2. November 13, 1941. The changes were very striking. There were remnants on the right of exudate on the temporal side of a pale cystic oval.

3. January 9, 1942. The central area was much flatter with a few small hemorrhages. Surrounding the entire five disc-diameter area was a broad, yellow-gray raised band. The central retinal vessels were larger.

4. February 20, 1942. The macula was depressed and encircled by a broader, smooth, elevated band.

5. July 27, 1942. The macula was a rough, white, slightly elevated mass in the hollow formed by the gray bands of great infiltration.

6. February 20, 1942. Left eye, vision was 4/200. A seven disc-diameter macular area was enclosed in a circinate-type partial ring of exudate. The center was degenerated with a few hemorrhages and a broad, white, organized outer border.

7. November 27, 1942. Left eye: the macular area was contracted to about three disc diameters with a faint hemorrhagic gray base over which the retinal vessels passed.

8. *Senile macular degeneration, exudative.* F. R., aged 67 years, was seen seven weeks after he had herpes ophthalmicus. Left eye, vision was 18/200. There was a 1.5 disc-diameter, white, flocculent-appearing, blood-topped mass in the macular region.

9. *Senile macular degeneration.* Mrs. J. C., aged 71 years, had systolic pressure of 212 mm. Hg. Left eye, vision was 1/200. A large nearly circular, several disc-diameter, whitish-yellow area occupied the macular region with a few hemorrhages external to the border.

10. *Senile macular degeneration.* J. H., aged 68 years, had lost the vision of his right eye four years ago. There was an advanced choroidal vessel sclerosis with atrophy. The sclera shone through a four disc-diameter area with irregular pigment to the lower, outer side and a few choroidal vessels on the floor.

11. *Syphilitic retinochoroiditis.* Mrs. A. K. P., aged 19 years, had congenital syphilis. In the left eye, vision was light perception. The fundus was pale with a soft, gray cloud in the macular region and many spots of choroidal pigment.

12. *Senile macular degeneration, exudative.* Mrs. E. K., aged 73 years, had systolic pressure of 156 mm. Hg. She had been unable to see for three months. Right eye, vision was 1/200. There was a large, several disc diameters, organized scar in the macular region with plaques of pigment in the center and a less-organized yellow border.

PLATE 21

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PLATE 22 (BEDELL). 1. *Myopia.* M. C., aged 50 years, had vision of 1/200 in the right eye. A gray macula hung over the large choroidal vessels.

2. *Myopia, senile macular degeneration.* Mrs. F. N., aged 60 years, had vision of 2/200 in the right eye, with a high degree of myopic astigmatism. A vertical, white patch was between the macula and the disc. Below it was a round, red area, larger than one disc diameter, of choroidal destruction, on the floor of which there was an irregular pigmentation.

3. *Myopia, macular degeneration.* Mrs. J. S., 27 years old. Right eye vision, 2/200. High degree of myopic astigmatism. A large, white choroidal scar and heavily pigmented macula.

4. *Senile macular degeneration* (July 10, 1940). Mrs. S. B., aged 67 years, had vision of 5/200 in the right eye. There was an irregular edema of the macular region with a U-shaped pigmentation.

5. January 9, 1941. The pigment was less marked but overlying its outer side were two flat hemorrhages.

6. *Senile macular degeneration.* Mrs. C. R., aged 67 years, had systolic pressure of 276 mm. Hg. Right eye, vision was 20/100. There was an irregular, gray, filmy macular area with a crescent of heavy pigment.

7. *Myopic cyst of the retina, retinal detachment.* Mrs. T. U., aged 74 years, had light perception only in the right eye. There was a very high degree of myopia with a large cyst to the temporal side of the partly detached retina.

8. *Myopia, choroidal atrophy.* Mrs. C. R., aged 50 years, had vision in the left eye of 1/200, with high myopic astigmatism. There was a one disc-diameter region of complete choroidal atrophy with an arc of dense pigmentation.

9. *Myopia, choroidal atrophy.* Mrs. M. K., aged 66 years, had vision of light perception in the left eye. There was a high degree of myopia with extensive choroidal destruction which encircled the disc and extended through and beyond the macular region.

10. *Myopia, rents in the choroid* (June 28, 1939). Mrs. P. M., aged 42 years, had vision of 3/200 in the right eye, with high myopic astigmatism. There were rents in the macular region with one circumscribed, round hemorrhage.

11. May 11, 1944. The tears were larger and deeper. The hemorrhage had disappeared.

12. *Myopia, macular degeneration.* B. M., aged 48 years, had vision of 1/200 in the right eye. A large, two disc-diameter, depressed scar was present in the macular region, with irregular, inferior pigmentation.

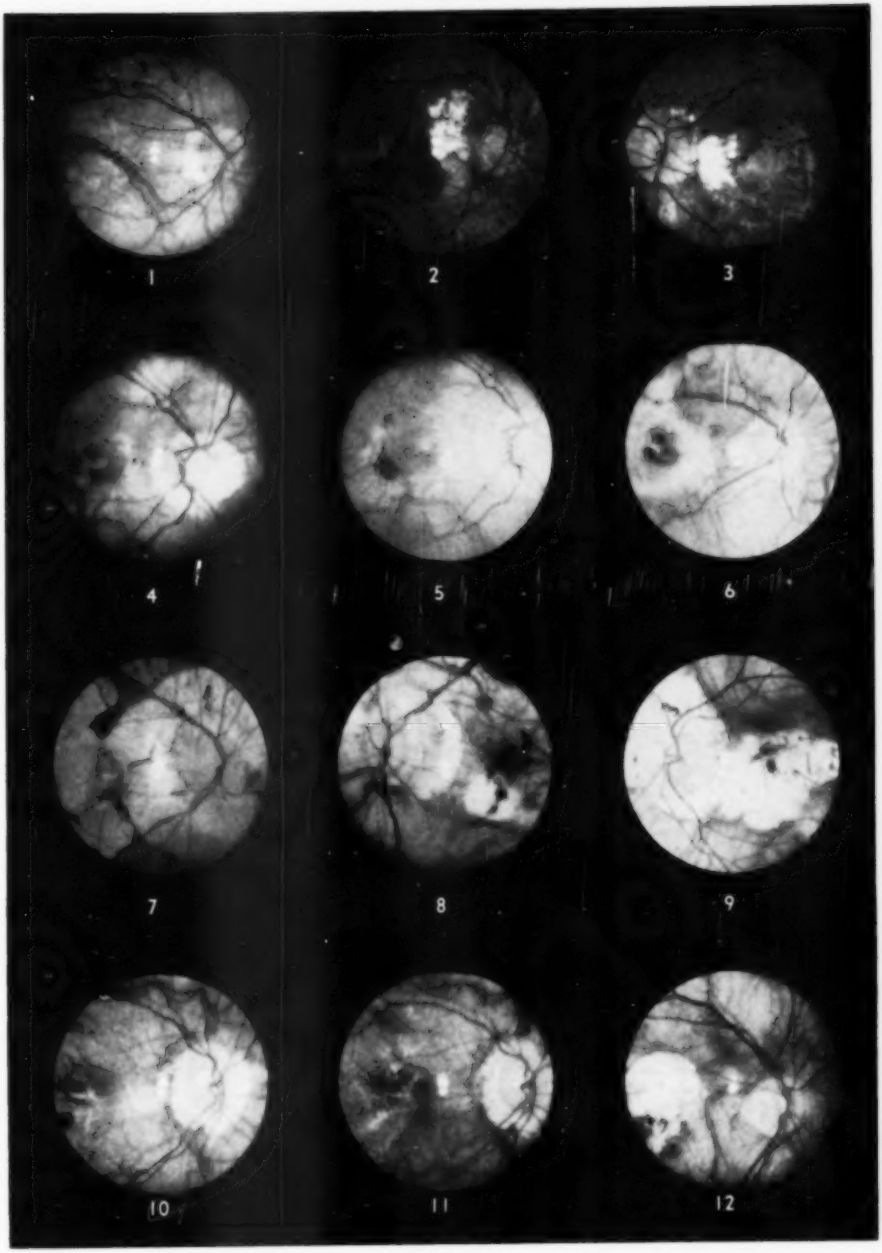

PLATE 22

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PLATE 23 (BEDELL). (This group illustrates some of the differences in appearance of the macular lesions found in myopia.)

1. *Myopia, macular degeneration.* Mrs. M. A., aged 75 years, had blood pressure of 112/68 mm. Hg. The vision in the left eye was 3/200. There was a small hemorrhage near the upper margin of the oval disc from which the vessels passed to the nasal side. The choroidal channels were clearly seen and the macula was a dark spot in a pale ring. There was very extensive macular and posterior polar degeneration with much pigmentation.

2. *Myopia, macular degeneration.* K. Z. was 60 years of age; blood pressure was 204/120 mm. Hg, and the blood sugar was 115 mg. percent. Vision in the left eye was 2/200, with widespread peripapillary and macular degeneration. The macular region was a dark spot with an oval hemorrhage below.

3. *Myopia, macular degeneration.* V. B., a woman, aged 49 years, had a systolic pressure of 178 mm. Hg and had been under treatment for some years. Right eye, vision was 1/200. The macular region was uneven with a 0.75 disc-diameter white scar with pigment on its surface. The choroid channels were large and in the disc there was a posterior staphyloma.

4. *Myopia, macular degeneration.* V. M. was 64 years of age when his poor sight made work as a tailor impossible. He had had iritis and had diffuse cortical lens opacities and a very small eccentric field. Right eye, vision was 1/200, with a high degree of compound myopic astigmatism. There was a large, inferior crescent around a normal disc with a 0.25 disc-diameter, dark macula and several small spots of choroidal atrophy.

5. *Myopia, macular degeneration.* M. C., aged 50 years, had a high compound myopic astigmatism. In the left eye the vision was 1/200 as a result of an irregular macular depigmentation with an oval, flat, pink hemorrhage close to the large choroidal vein.

6. *Myopia, macular degeneration.* E. D. was 29 years of age when he was seen after having been struck over his right eye by a horse-shoe a year previously. The disc was oval. With a −14.0D. sph. the vision was 1/400. There was a bright red ring about the macula with pigmentation temporally.

7. *Myopia, macular degeneration.* Mrs. A. C., aged 58 years, had vision of 3/200 in the left eye. There were several white spots of complete choroidal loss and in the macula, a dark 0.25 disc-diameter ring.

8. *Myopia, macular degeneration.* The vision of the right eye was 2/200 unimproved even with a −7.0D. sph. ⊂ −3.0D. cyl. ax. 15°. The macula was a dark, one-third disc-diameter circle in a quadrate loss of choroid. There were several similar scars about the disc and above the macula.

9. *Myopia, macular degeneration.* F. D., a 59-year-old man, had a detached retina in his right eye. Left eye, vision was 20/100, with a −17.0D. sph. ⊂ −1.0D. cyl. ax. 180°. The macular region was irregularly depigmented and the central excavation of the disc was like that of a far-advanced glaucoma. The intraocular pressure was 20 mm. Hg (Schiötz).

10. *Myopia, macular degeneration* (April 6, 1941). Mrs. I. P. was 60 years of age when she was first seen. The vision in each eye was 3/200 as a result of bilateral macular degeneration. (Three photographs show the progression in the right eye during nine years of observation.)

Right eye, vision was 3/200. There was a sharply outlined, horizontal, pale oval of almost two disc diameters in the macular region with pigmentation near its lower border.

11. February 28, 1944. The central macular area was heavily pigmented and surrounded by a broad, white band of complete choroid loss.

12. June 20, 1947. The pigmented portion is unchanged but the atrophy had increased, forming a large, white inverted horseshoe.

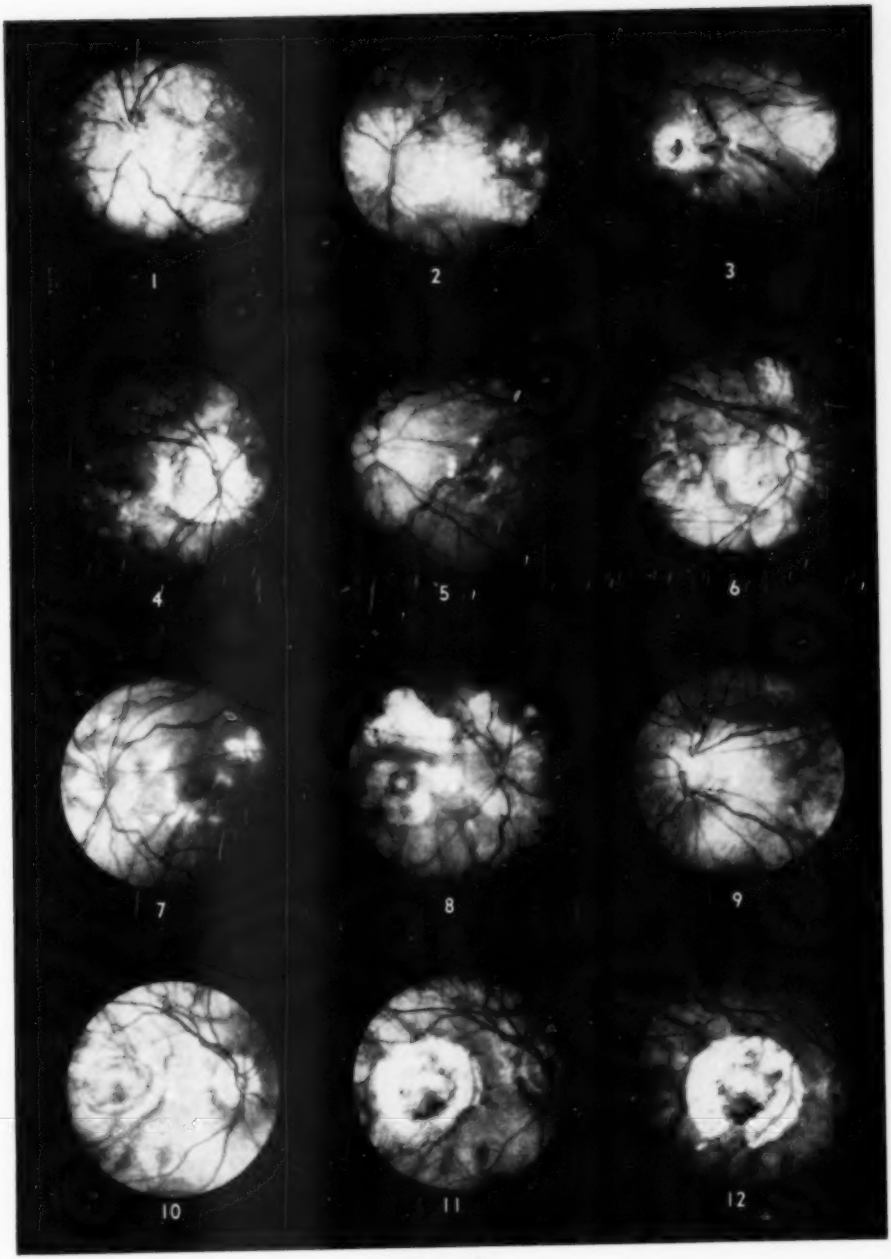

PLATE 23

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PLATE 24 (BEDELL). 1. *Macular retinochoroiditis* (January 17, 1942). Mrs. M. R., aged 32 years, had blood pressure of 112/70 mm. Hg. There was a 10-degree central scotoma in the right eye with vision of 20/30. The two disc-diameter macular region consisted of three portions. The center was elevated, 0.25 disc diameter, with a grayish-green cyst on top of a dark-red hemorrhage, which was surrounded by an incomplete gray ring. Beyond that the border consisted of innumerable narrow radiations.

2. April 26, 1947. The terminal stage. Vision, 20/200. A black, central scar had a pale border and an irregular outer ring.

3. *Retinochoroiditis.* Mrs. A. S., aged 55 years, had systolic pressure of 212 mm. Hg. Right eye, vision was 10/200. There was a large, oval, white scar with irregular pigmentations.

4. *Retinochoroiditis.* L. M., aged 50 years, had had poor vision for one year. Right eye, vision was 20/50. There was a circumscribed macular scar.

5. *Retinochoroiditis.* Mrs. A. M., aged 35 years, had had a divergent right eye for three years, with decrease in vision. Right eye, vision was 10/200. A large, heavily pigmented, depressed macular scar was present.

6. *Myopia, retinochoroiditis.* Mrs. P. G., aged 43 years, had high myopic astigmatism. There had been spots before her right eye for five days. Right eye, vision was 2/200; with correction, 20/50. The retina was irregularly depigmented with a gray, soft area to the upper outer side of the macula.

7. *Choroidal vessel sclerosis.* Miss H. L., aged 46 years, had sudden loss of vision in the left eye seven years ago. Vision was 1/200, with very extensive choroidal sclerosis and pigmentation.

8. *Retinochoroiditis.* R. M., aged 49 years, had had poor vision for at least 25 years. There were small fields, with central scotoma, bilaterally. Right eye, vision was 3/200. The macular region was white, surrounded by a pigment ring with a large extension to the temporal side. The arteries and the veins were very narrow.

9. *Senile macular degeneration.* A. R., aged 84 years, had general arteriosclerosis. His vision had been poor for three weeks. Left eye, vision was 4/200. There was a large central excavation. Intraocular pressure was 14 mm. Hg (Schiøtz). There was an irregular depigmentation over a reddish-gray 1.5 disc-diameter area which encroached upon the macula.

10. *Retinochoroiditis.* Mrs. E. P., aged 29 years, had vision of 20/200 in the right eye. Macular retinochoroiditis with a white scar and heavily pigmented center was present.

11. *Pregnancy macular star.* Mrs. M. D., aged 30 years, lost her vision when she was four and one-half months' pregnant. Blood pressure rose to 240 mm. Hg. Pregnancy terminated. Left eye, vision was 20/50. There was a complete macular star with retinal edema, many small cotton-wool exudates, and marked spastic changes in the arteries.

12. *Retinochoroiditis.* R. S., aged 46 years, had vision of 20/20 in the left eye. A large scar to the nasal side of the disc was similar in appearance to that which is commonly seen in the macular region.

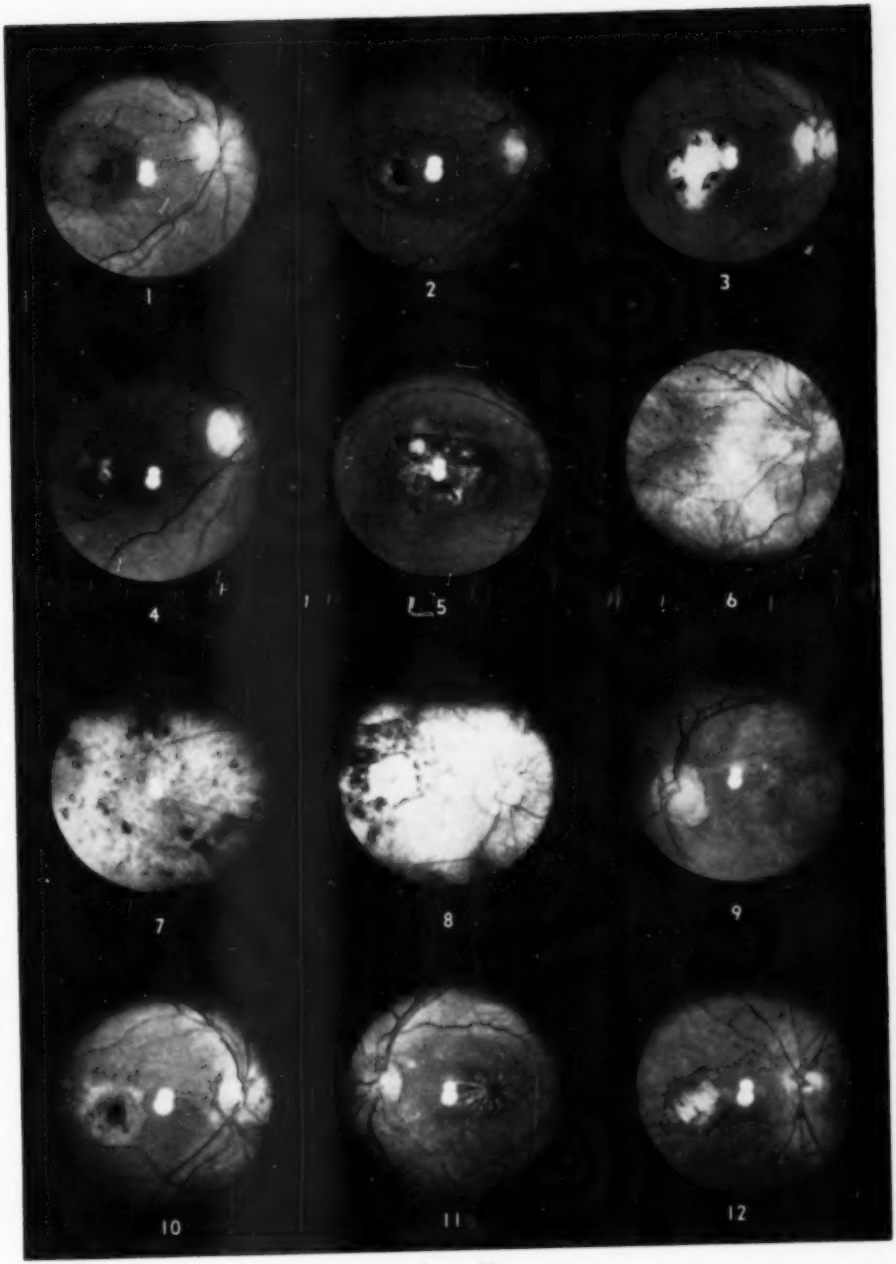

PLATE 24

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PLATE 25 (BEDELL). 1. *Senile macular degeneration.* Mrs. C. G., aged 50 years, illustrates how the tissue age differs from the chronological for the fundus changes were similar to those found in the elderly. A broad triangle of blood partially concealed the gray, edematous macula.

2. February 3, 1942. An almost complete ring of blood surrounded the gray macula.

3. December 19, 1941. The edema of the macula was less with a large hemorrhage below.

4. December 3, 1941. The macular edema was decreased. Over its apex was a large, curved, flat, superficial hemorrhage.

5. November 19, 1941. The edematous macular region, a little larger than the disc in diameter, showed as a pale swelling with an arc of blood to the outer side.

6. *Tubercular retinochoroiditis* (October 28, 1939). P. F., 38 years of age, had had an active pulmonary tuberculosis eight years before. Left eye, vision was 20/200. The macular region was gray and elevated, with a broad arc of blood forming its inferior margin.

7. August 15, 1941. After several recurring hemorrhages, the eye was quiet with a large, macular scar with a long, inferior extension and a few fresh hemorrhages about the center. The scar of a healed tubercle was between the inferior vessels.

8. *Senile macular degeneration* (September 6, 1940). D. D., aged 86 years, had systolic pressure of 156 mm. Hg. Vision had been failing for six months and now was unable to read. Left eye, vision was 1/200. A bright red, deep, flat hemorrhage almost the size of the disc covered the macula.

9. September 23, 1942. The choroidal vessels were visible in a large, irregularly pigmented area about the macula.

10. *Senile macular degeneration* (September 13, 1939). Mrs. A. A., aged 63 years, had vision of 1/200 in the right eye. There were several flecks of blood remote from the grayish-yellow macular swelling.

11. November 29, 1943. There was less swelling but much greater pigmentation on a three disc-diameter central area.

12. November 20, 1948. There were widespread pigment deposits on a large slightly depressed, pale macular scar.

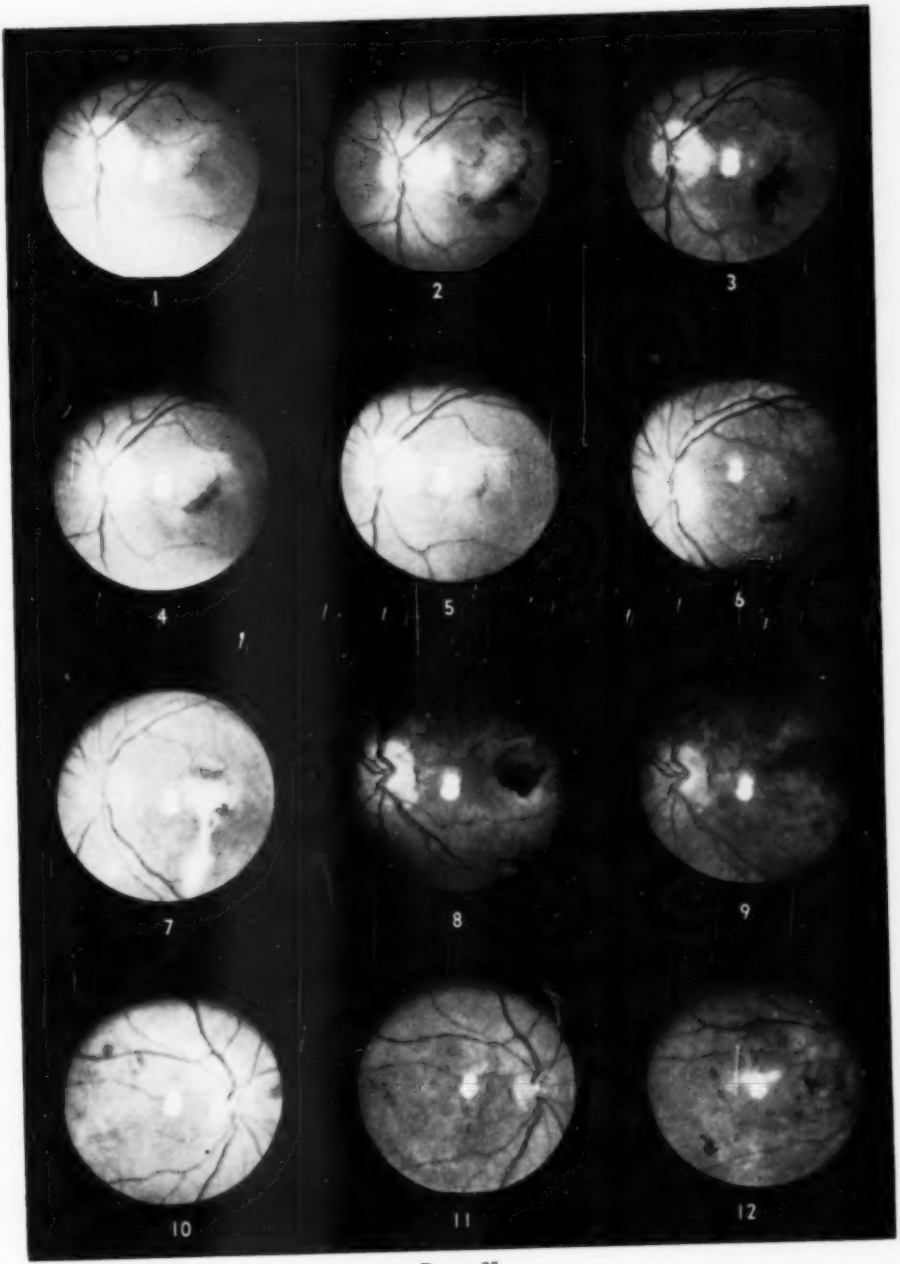

PLATE 25

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PLATE 26 (BEDELL). 1. *Senile macular degeneration* (January 14, 1943). Mrs. M. H., aged 82 years, had vision of 1/200 in the right eye. There were several small hemorrhages over a gray macular region with marked retinal edema.

2. *Retinitis proliferans* (September 16, 1943). There was an extensive gray exudate in a three disc-diameter macular area and in a wide zone including the disc.

3. April 27, 1944. The marked increase in the retinal swelling was evidenced in a great roll above and below the disc, extending to and including the macular region.

4. April 27, 1944. The great swelling had flattened, leaving a large, gray oval which encircled the disc and extended four disc diameters temporally. The macula was comparatively clear.

5. May 16, 1945. The exudate had organized into a white sheet which was beneath the retinal vessels leaving a circular window over the macula.

6. *Senile macular degeneration* (March 10, 1943). (This and the preceding case show how some retinal and choroidal exudates may develop unusually thick, bizarre white scars.)

Miss H. C., aged 70 years, had had poor vision for nine months. The systolic pressure was 170 mm. Hg. Recently she had lost 50 pounds. Right eye, vision was 20/200. A large macular lesion was partially pigmented and outlined by a white, uneven, edematous layer.

7. *Retinitis proliferans* (March 18, 1943). There were several retinal hemorrhages close to the superior temporal vein above and one in the macular region. The pale portion of the macula remained the same size.

8. September 17, 1943. The part of the infiltration which was thickest was now clear and the rest of it was a white, thick, slightly elevated sheet which extended upward beyond the superior temporal vein. There were a few fresh hemorrhages near the base. The older ones had almost disappeared.

9. January 12, 1944. There was a bizarre-shaped white scar in the macular region.

10. August 14, 1947. Vision was 20/200. The retinitis-proliferans layer showed three distinct openings, one over the macula and one to each side of it.

11. *Senile macular degeneration.* Mrs. E. P., aged 70 years, had noticed that the sight in both eyes had been failing one year. Left eye, vision was 6/200. A crown of deep blood of uneven width encircled the macular area which was an edematous, slightly elevated, gray-yellow oblong of 2.5 disc diameters. There were a few flecks of retinal blood on the apex.

12. *Senile macular degeneration.* C. S., aged 82 years, had systolic pressure of 168 mm. Hg. Right eye, vision was 4/200. The macular region was a large, elevated, whitish-yellow mass. The surface was puckered like a cellophane layer. There were a few hemorrhages below the inferior border. The left eye was the same.

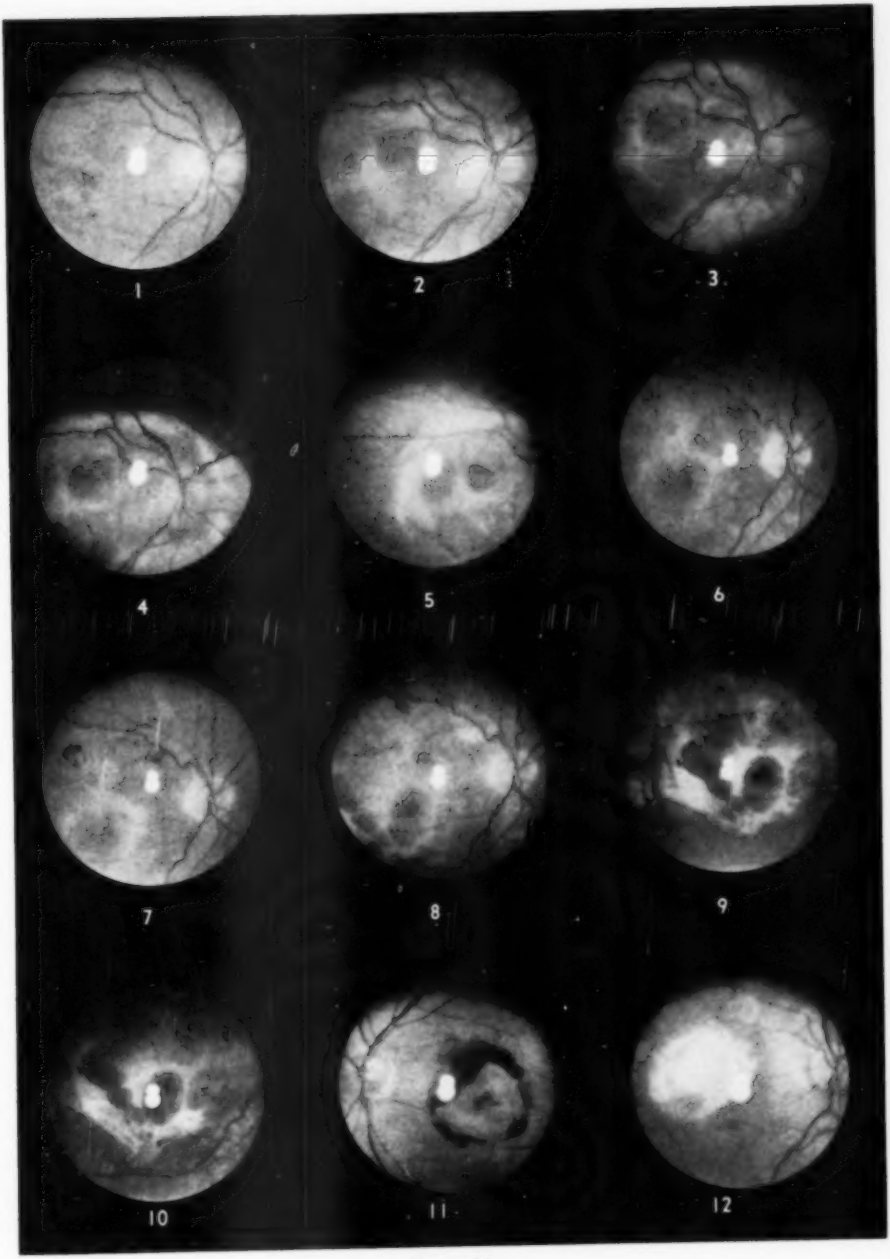

PLATE 26

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PLATE 27 (BEDELL). (A complete photographic record of one type of macular degeneration in the elderly.)

1. *Senile macular degeneration* (October 18, 1939). A. S. was 75 years of age when the first photograph was taken. Right eye, vision was 20/100 with an eight-degree central scotoma and a scarcely perceptible grayness of the macula.

2. March 18, 1940. The macular area was about one disc diameter in size, with a cloudy-gray enclosing band. Beneath the superior temporal artery there was a linear extravasation about a disc diameter in length.

3. December 22, 1942. The macular destruction had increased to the upper disc side and there was a faint V-shaped hemorrhage between the disc and the macula.

4. February 16, 1944. There was slight shrinking in the macular area and an increase in the pigmentation, especially near the upper temporal border.

5. The macular area was still larger. In the center of the primarily affected region, there was a fresh clot of blood and to the temporal side a large, granular extravasation almost the size of the involved macular region.

6. June 15, 1946. The macular region was more distinctly outlined. It was pinker and the central hemorrhage was slightly larger.

7. October 18, 1939. Left eye, vision was 3/200. There was a round, irregularly depigmented area in the macular region about the size of the disc with one small hemorrhage on its outer border.

8. There was an irregular C-shaped cloud between the disc and the irregularly pigmented center. In a ring about one-third disc diameter in width, beyond the outer margin of the macular area, there were several, small, irregular, granular hemorrhages forming an incomplete arc.

9. December 22, 1942. The macular region was puckered with several small vessels on its surface and a few irregular flecks of pigment above.

10. December 16, 1944. The pigment in the upper border of the area had increased. The lower part was still paler and the blood vessels on the surface were visible.

11. June 15, 1945. The entire macular region was contracted with more pigmentation.

12. June 15, 1946. The scar was flat with pigmented top and a yellow-gray base.

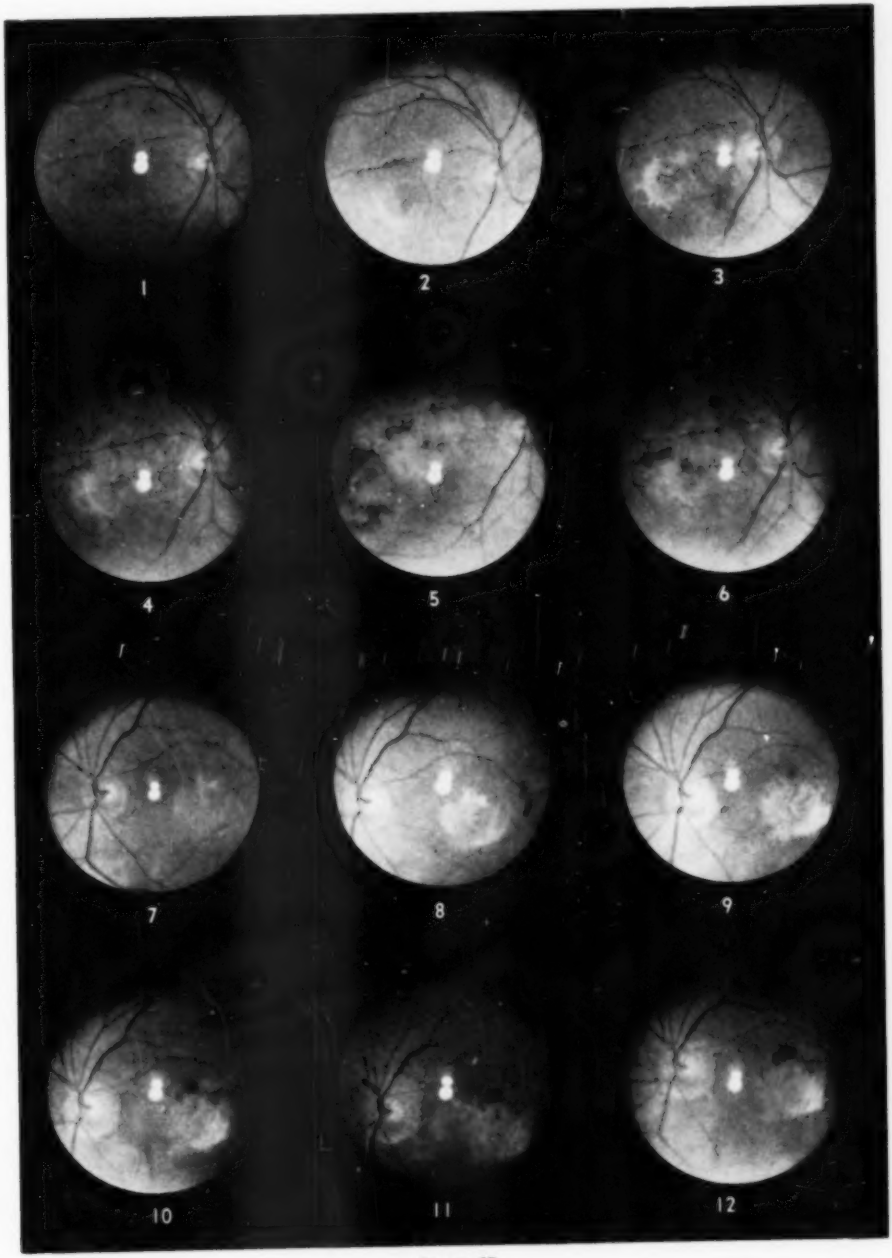

PLATE 27

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PLATE 28 (BEDELL). 1. *Senile macular degeneration* (April 26, 1940). Mrs. E. L. was first seen when she was 76 years old. The vision in the right eye was 20/40, uncorrected, and the macula showed a very thin, soft, 0.75 disc-diameter, gray cloud.

2. June 1, 1940. An arc of pigment was overshadowed by a gray cloud of almost one disc diameter. Remote from the pigment line was a narrow streak of blood.

3. July 5, 1940. The cloud region was the same size but the center was palest. One small hemorrhage was on the lower border.

4. August 15, 1940. The gray cloud was decidedly smaller with ill-defined borders. The dark arc was a trifle wider and below, toward the disc, was an irregular patch of lacelike exudate.

5. August 29, 1940. The macular involvement was decidedly greater, almost green-gray in color, and the exudate was more than twice as large.

6. September 25, 1940. The gray macula was decidedly flatter, a soft gray, with several streak hemorrhages on its margin.

7. October 23, 1940. There was more contraction of the macular area. The swelling was more irregular and the surface was more uneven with several hemorrhages over and about it. The exudates were less defined.

8. December 2, 1940. The superior hemorrhages were very much smaller but some recent ones were decidedly larger.

9. January 20, 1941. The macular area had shrunken and consisted of two portions separated by an arc of pigment. The larger was below and beyond the pigment. The hemorrhages were thinner but covered a greater surface. The exudates were isolated.

10. March 7, 1941. The macula was flatter but the region adjacent to it was more elevated, rounded and grayer. The hemorrhages were large and more widespread.

11. April 22, 1942. There was marked choroidal vessel sclerosis in a four disc-diameter area. The macular region was depressed.

12. August 11, 1942. The ovoid, gray scar was flat and well circumscribed, with an arc of thin pigment. The vision was 2/200.

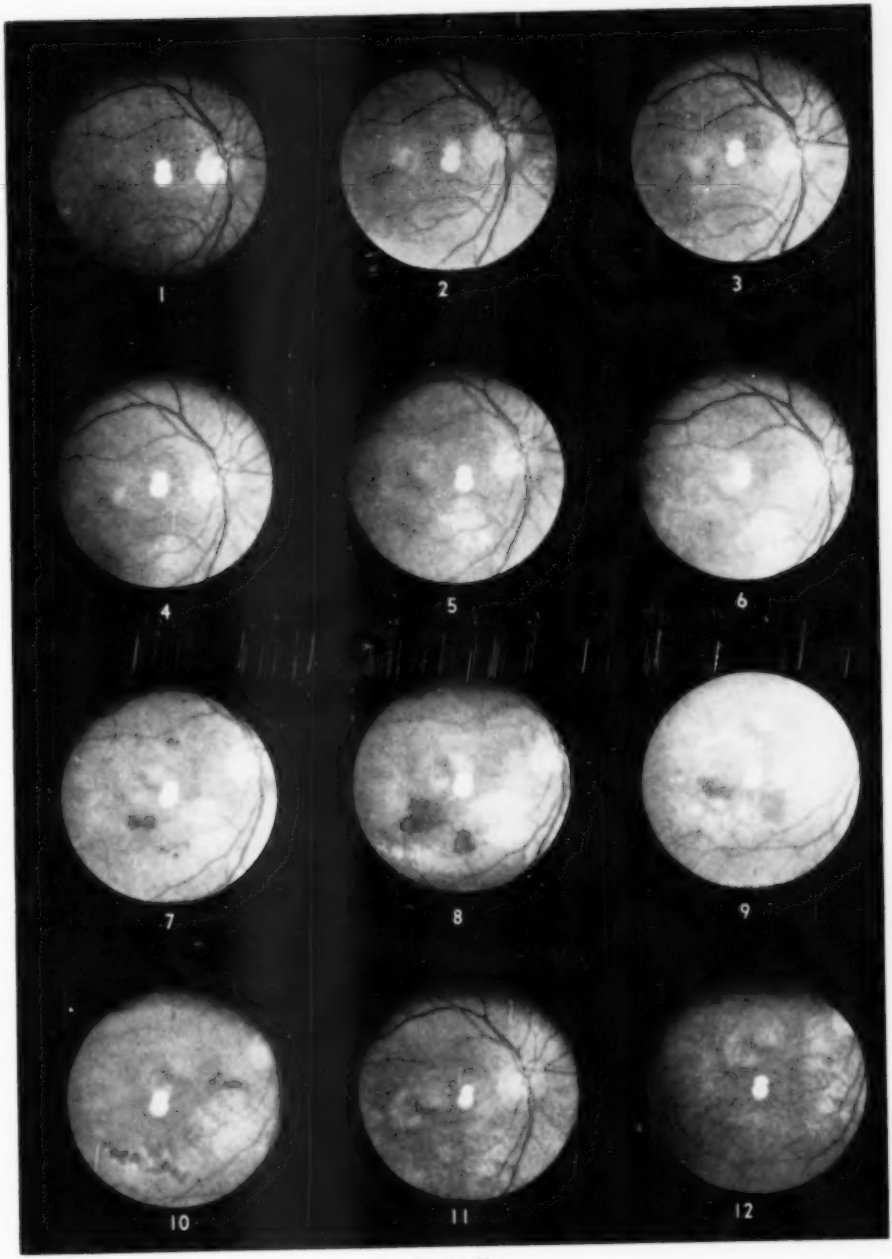

PLATE 28

SPONTANEOUS CYSTS OF THE CILIARY BODY SIMULATING NEOPLASMS*

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New York

In the routine microscopic examination of eyes removed for various causes, it is not uncommon to see single or multiple intraepithelial cysts in the valleys between the ciliary processes (figs. 1, 2, and 3). When these cysts are small, they are undetected and unimportant clinically, but, when large, they may be clinically demonstrable. Arising as they do from the anterior portion of the corona ciliaris, and commonly involving the base of the iris, they may manifest themselves as iris lesions.

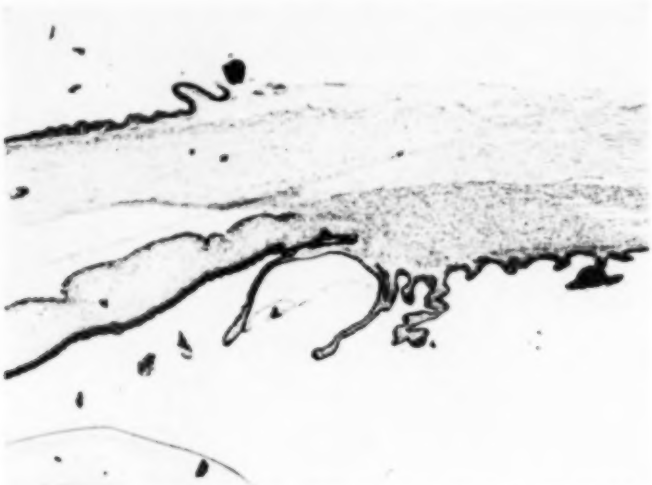

Fig. 1 (Reese). There is a cyst between two elongated ciliary processes. The medial wall of the cyst, composed of the nonpigmented epithelium, has collapsed in preparation and is seen folded and lying in the cyst space. The cyst has pushed the root of the iris forward, blocking the filtration angle. The globe shows a diffuse active choroiditis but no history is available regarding the clinical findings.

Microscopic examination reveals that the wall of this type of cyst, which may be from one to four cells thick, is composed, in part, of the pigmented layer of the ciliary epithelium but principally of the nonpigmented layer. The cyst represents, in fact, a localized separation of the two epithelial layers. Around its base there is a transition between the epithelium of the wall and the pigmented epithelium, the latter remaining virtually unchanged. A cystic adenoma (benign epithelioma) of the ciliary body may resemble such a cyst (fig. 6).

The cysts may be multiple and the process may not be confined to the corona ciliaris but may involve the same epithelial layers over the periphery of the iris (fig. 4), or over the pars plana of the ciliary body (fig. 5). In lesions involving the iris, the entire epithelial wall will be pigmented. If the pars plana is involved, the cyst will be flat instead of globular.

Normally filled with a clear fluid, the cysts

*From the Institute of Ophthalmology of the Presbyterian Hospital. Presented at the 85th annual meeting of the American Ophthalmological Society, Hot Springs, Virginia, June, 1949.

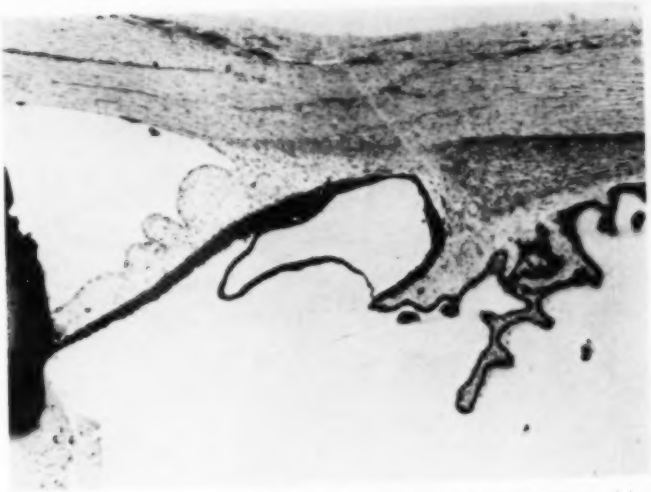

Fig. 2 (Reese). There is a cyst at the base of the iris at the junction between the iris and the ciliary body. The inner wall of the cyst is composed of pigmented epithelium which is partially collapsed in preparation. The cyst has pushed the periphery of the iris forward, blocking the filtration angle. This cyst was not detected clinically. The globe was enucleated because of secondary glaucoma.

Fig. 3 (Reese). There is a large collapsed cyst between two ciliary processes. The inner wall of the cyst is composed of nonpigmented epithelium which is collapsed and in folds as a result of the preparation of the specimen. In vivo the cyst extended quite far along the posterior surface of the iris. The cyst pushed the iris forward against the cornea and, as a result, there has been some proliferation and pigment changes in the iris. (Patient of Dr. Raymond Meeks.)

Fig. 4 (Reese). There is a large intra-epithelial cyst at the base of the iris and smaller cysts between the ciliary processes. This was the left eye of a woman, aged 63 years. Back of the iris, extending from the 5- to the 8-o'clock positions, was a dark-brown mass which appeared to be in the ciliary body. The anterior chamber was somewhat more shallow from the 3- to the 4-o'clock positions due to the protrusion forward of the iris. The lesion failed to transilluminate light. The lesion simulated a melanoma of the iris and ciliary body. (Patient of Dr. Joseph Mandelbaum.)

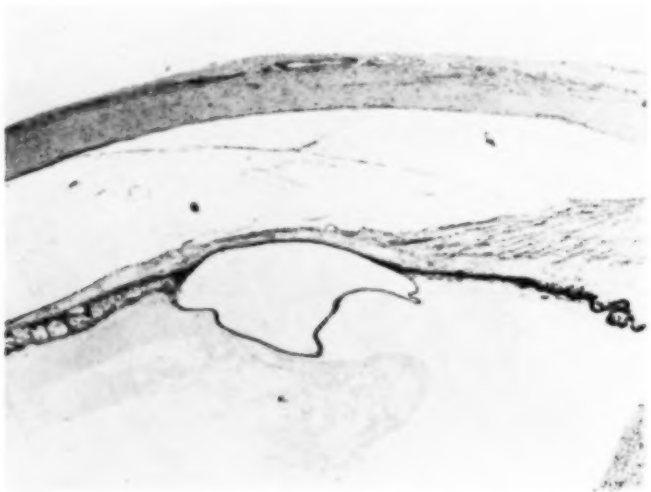

Fig. 5 (Reese). A cyst of the flat portion of the ciliary body. The inner wall is composed of the nonpigmented epithelium and the outer wall of the pigmented epithelium. The eye was removed because of glaucoma secondary to occlusion of the central vein.

are largely evacuated in the process of preparing sections.

It is impossible to estimate the incidence of these cysts but in one degree or another they appear to be not uncommon. Rabitsch,[1] Ichikawa,[2] and Loewenstein and Foster[3] have reported finding them coincidentally in eyes removed for other purposes.

Histologically their presence has been noted 46 times in my collection of slides as a coincidental finding in eyes removed for a great variety of causes and in otherwise normal eyes removed for the purpose of insuring adequate irradiation of a malignant tumor of the sinuses. In addition, 12 clinical lesions have been observed which are believed to be examples of this type of cyst.

Clinical examination of the ciliary body with a gonioscope through an operative coloboma of the iris may reveal their presence. They have been observed by this method by François[4] and by Dunnington.[5] In my experience they have appeared to be far more common both microscopically and clinically than the similar type of intra-epithelial cyst of the iris which arises in the pupillary area, supposedly from a patent marginal sinus.

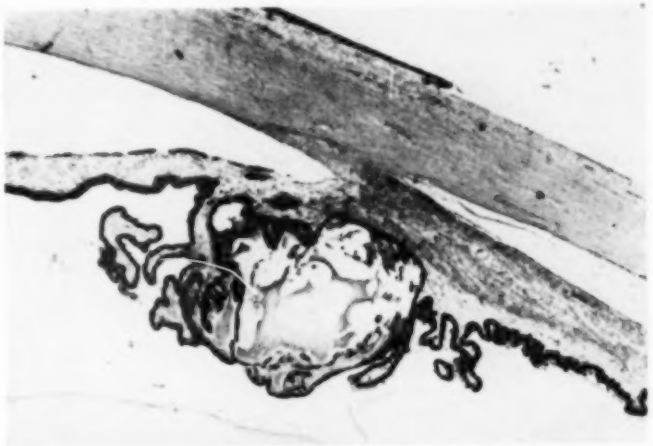

Fig. 6 (Reese). A cystic adenoma (benign epithelioma) of the ciliary body resembling a cyst. The lesion was not detected clinically. The eye was removed because of malignant melanoma of the conjunctiva.

Origin of the Cyst

In the embryonic eye the internal and external layers of the secondary optic vesicle are not united but merely lie in apposition, and in the postnatal eye the structures derived from these two layers are also in loose apposition. In the posterior portion an actual separation of the layers gives rise to a detachment of the retina; over the iris and ciliary body such a separation manifests itself as a cyst. In the iris when the marginal sinus remains patent the site of predilection is the pupillary area.

There is no apparent explanation for the occurrence of these cysts. A localized incomplete coaptation of the inner and outer layers of the secondary optic vesicle may serve as a patent space which later enlarges. At about the sixth fetal month the forerunners of the ciliary processes are seen as ridges or folds of the two epithelial layers. Sometimes these folds are characterized by a separation of the two epithelial layers, particularly at the junction between the iris and the ciliary body.

It is possible that the intra-epithelial cysts under discussion are predisposed to occur at the base of the iris because, in this transitional area, the tendency for the two epi-

Fig. 7 (Reese). Small translucent cysts can be seen between the ciliary processes as viewed with the gonioscope through an operative coloboma. An iridectomy was done because of a melanoma of the iris. (Patient of Dr. J. H. Dunnington.)

thelial layers to separate is carried over from fetal life. This explanation seems inadequate in that it fails to account for the impetus to cyst formation.

As previously stated, the cysts occur not only in apparently normal eyes but in eyes exhibiting a great variety of pathologic conditions, and there are no indications that they are related to the pathologic process for which the eyes have been enucleated.

Greeff[6] described the blebs occurring in the ciliary body of rabbits due to the separation of the epithelial layers from the stroma. If the rabbit's eye is enucleated 10 minutes after a paracentesis of the anterior chamber, there is present a hyperemia of the ciliary

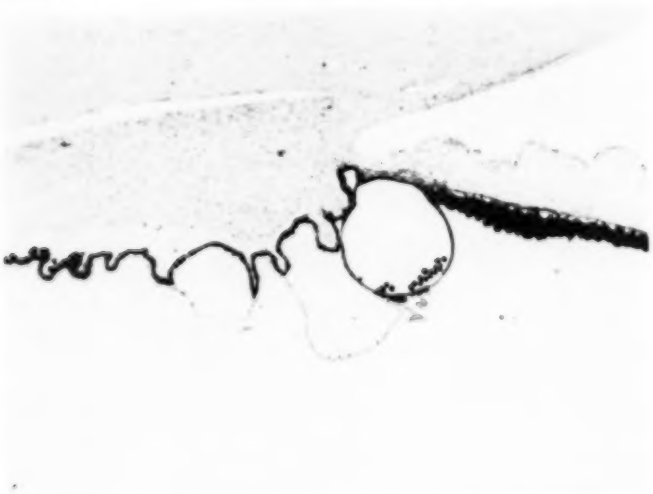

Fig. 8 (Reese). There are three cysts. Two of these are between ciliary processes and one is at the base of the iris. The wall of the latter cyst is composed entirely of pigmented epithelium and in the cyst space are some proliferated desquamated pigmented epithelial cells. These cysts were not detected clinically. The eye was removed because of malignant melanoma of the choroid.

body and a detachment of both layers of the ciliary epithelium. In this way, cysts filled with an eosin-staining fluid are formed between the stroma and the epithelium. This lesion was interpreted as a proof of the secretory function of the ciliary body.

The cysts under discussion in the present paper occur between the nonpigmented and the pigmented epithelial layers of the ciliary body and not between the layers of the ciliary epithelium and the stroma, and it seems highly improbable that they are related to Greeff's blebs or to the production of aqueous by the ciliary body.

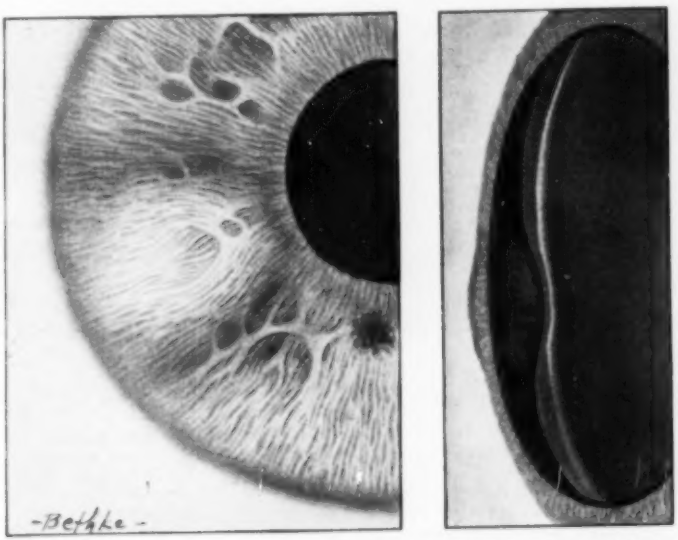

Fig. 9 (Reese). In the right eye of a man, aged 35 years, the iris bulges forward almost to the point of touching the posterior surface of the cornea. The angle is greatly narrowed but could be seen with a gonioscope. The lesion transilluminates light well. Through a dilated pupil, a globular cyst can be seen posterior to the iris at the site where the iris is pushed forward. Over the area where the cyst indents the lens, the zonules are missing. Posterior to the cyst, several ciliary processes can be seen magnified. Over a period of two years and three months' observation the lesion has not changed. (Patient of Dr. Daniel Rolett.)

Clinical significance and differential diagnosis

When these ciliary body cysts are small, they have no clinical significance. When they are large, however, they may manifest themselves in a number of ways:

1. The periphery of the iris may be pushed forward so that a distinct localized narrowing or obliteration of the angle may be observed (figs. 1, 2, 8, and 9). This process may even embarrass the filtration angle sufficiently to produce glaucoma, as illustrated in cases reported by Wintersteiner[7] and Pagenstecher.[8] In Pagenstecher's case, the author observed the development of the cyst over a six-month period; the glaucoma produced was transitory.

2. The cyst may push the anterior surface of the iris against the posterior surface of the cornea and, when this occurs, the friction of the iris stroma against the cornea may incite proliferation and pigment changes highly suggestive of a melanoma.

Such a sequence occurred, in my opinion, in the case described by Meek[9] (fig. 8). Although this case was reported as a melanoma of the ciliary body and iris, the author stated

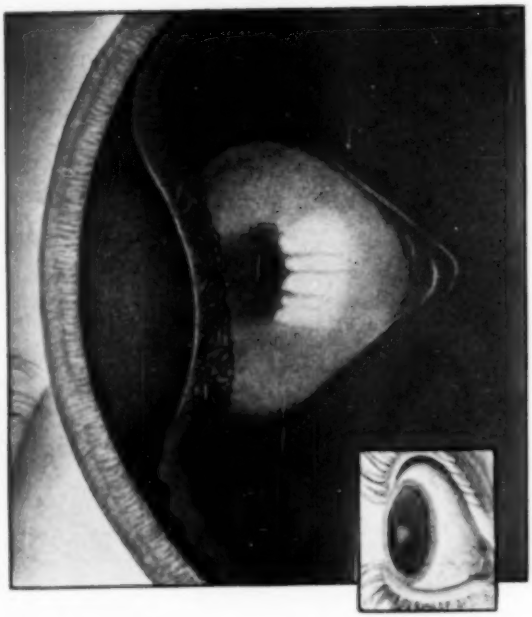

Fig. 10 (Reese). During a routine eye examination of a girl, aged 16 years, a small coloboma of the lens was noted in the right eye at the 7-o'clock position. Through a dilated pupil, it could be seen that a cyst over the ciliary body was responsible for the lens change. If the eye was moved while the lesion was being observed, some tremulousness of the cyst was noted. There were some cataractous changes around the lens coloboma. The eye has been observed at yearly intervals for four years and no change has been noted. (Patient of Dr. Arthur Yudkin.)

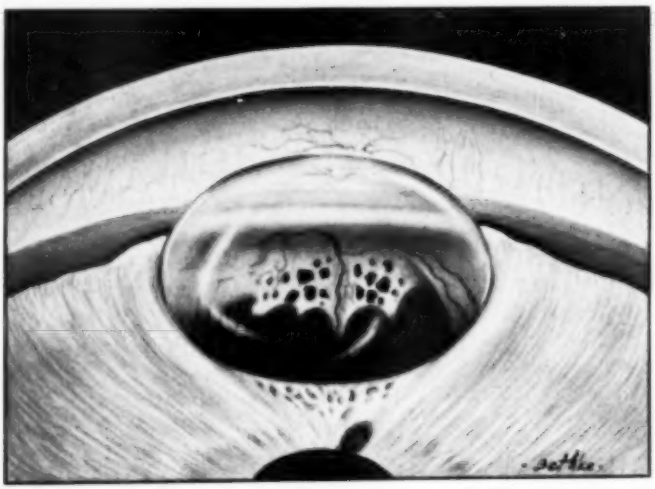

Fig. 11 (Reese). A spontaneous cyst in the periphery of the iris. A man, aged 43 years, noted the lesion for the first time in 1946. An examination at this time showed a cyst, 3.0 by 1.5 mm. The cyst was transparent and apparently extended through the iris stroma. The cyst enlarged over the succeeding five months. (Patient of Dr. J. H. Dunnington.)

that there was a difference of opinion as to the true nature of the lesion. I have had an opportunity to study sections of Meek's case and believe it to be primarily a cyst of the ciliary body with secondary iris changes, that is, an example of the type of cyst discussed in this paper.

3. The cyst may extend along the posterior surface of the iris (fig. 4) and is then most likely to simulate a melanoma because the cyst wall, composed as it is of pigmented epithelium, interferes with the transillumination of light and gives the lesion an especially dark color which may be noted in the pupillary area.

Important differentiating points in cases involving the iris are that the cyst protrudes from the posterior surface of the iris in the periphery, is smooth, and may be slightly tremulous. When it arises from its usual site in the corona ciliaris (figs. 9 and 10), it has a smooth surface, a dark color (principally by virtue of its inaccessible location), transilluminates light, may be tremulous, and may indent the lens with or without secondary localized cataractous changes.

A bright focal light thrown on the lesion may penetrate the cyst sufficiently to give a reddish reflex from the underlying uvea and may reveal magnified ciliary processes posterior to the cyst (fig. 9). Because of the clear fluid content and the lack of pigment in the epithelium composing the cyst wall facing the posterior chamber, transilluminated light may have a refractile quality which accentuates the cyst. This is in direct contrast to what occurs in the case of a melanoma.

There is a type of translucent cyst which may occur in the periphery of the iris and produce a lesion simulating an iridodialysis. Elschnig[10] and Villard[11] have described this lesion, and Dunnington[12] has had a case under observation (fig. 11). All three lesions were surprisingly similar in clinical appearance. I suspect them to be cysts of the type discussed in this report but there is reason for doubt in the fact that tissue excised from the wall of Dunnington's case revealed an epithelial lining unlike the epithelium of the ciliary body. It was a stratified cuboidal epithelium more like that of the conjunctiva, although there was no history of operation or injury. In both Elschnig's and Dunnington's cases there were recurrences following excision of the cyst wall.

In most of the cases observed by me, there has been no appreciable enlargement of the cyst over a period of years and the lesion has been considered significant only insofar as it could be confused with a neoplasm or could produce glaucoma. In its usual location in the ciliary body, the cyst can hardly be excised without irreparable damage to the eye but, if it involves the iris predominantly, excision may be feasible. No surgical procedure is indicated, however, unless demanded by diagnostic necessity or unless the integrity of the eye is jeopardized by progression of the lesion. Irradiation has never been tried.

Summary

A not uncommon type of spontaneous intra-epithelial cyst of the ciliary body is discussed. The lesion may be restricted to the ciliary body or it may be so extensive as to involve the iris. From a clinical standpoint, it may then manifest itself as an iris lesion, may be confused with a neoplasm, and may produce glaucoma.

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THE VISION OF ADOLESCENT BOYS*

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Both school[1-6] and industry[7-9] have, within the past few years, become increasingly aware of the importance of vision testing and consequently several screening devices[8] have been developed. The purpose of these screening devices is to select those persons whose vision requires professional eye care; the value of such a device is appraised on the basis of its ability to pick out all those who really need this extra examination without needlessly referring many others.

Recently studies of the relative efficiency of several screening devices have been undertaken.[8-10] One part of the general problem of developing good screening methods is the determination of the ranges of visual data which one finds when an unselected group is examined. A study of such data will assist in determining what should be accepted as the normal limits for any given test and will also permit an advance estimate of what the examination of any group is likely to reveal.

It is to be remembered, however, that a high frequency of any particular finding does not necessarily indicate that it is the optimum condition: naked vision of 20/20 occurs in a much higher percentage of adolescents than does any other figure, but this is not incontrovertible evidence per se that 20/20 vision is optimal or necessary for all persons.

METHOD

This paper presents data obtained at the screening eye examinations of 1,129 different adolescent males ranging in age from 13 to 19 years. None of these individuals was included in a previous report[6] so the data in that report may suitably be compared with the present findings. All the data were obtained over a three-year period at the time of the annual health examination of students at a preparatory school. The same technician did all these screening tests, and all were carried out using a modification of the Massachusetts Vision Test.[9] The efficiency of this screening device has previously been

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discussed [8,9] and will be the subject of a future report.[11] The slight variation in visual acuity which is found at each age in the 13- to 19-year period[1,4,13] makes the division of these data into separate age groups unnecessary. In the Massachusetts Vision Test a cyclopegic is not used.

Results and Comments

Visual acuity

Visual acuity was determined without glasses if these were worn. A properly illuminated American Optical Company chart No. 1,930 at 20 feet from the subject was used. More than two errors in the 20/20, 20/25, and 20/30 lines and more than one error in the 20/40, 20/50, and 20/70 lines was considered a failure of that line.

Table 1 indicates that 72.0 percent of this group had 20/20 binocular vision. This figure is similar (76.5 percent) to that obtained with the same test upon a different group of 797 boys[8] and to that reported (80.06 percent) on a group of 715 boys;[6] and similar to that of Collins and Britten[1] who found 69 percent of boys in the 13- through 16-year period to have 20/20 vision or better in both eyes. The lower figure for the last group can be explained on the basis of its referring to 20/20 vision in each eye, while the other reports refer to 20/20 vision when both eyes are used together to read the chart.

On the basis of referring for a further examination all those who had less than 20/25 vision in one eye, about 30 percent of the group described in Table 1 would have been selected; if the basis were less than 20/25 vision in both eyes, 26 percent would be referred; if only those whose vision was less than 20/30 in one or 20/30 in both eyes were considered, about 25 and 21 percent respectively would be referred. It is to be remembered that 350 members of this group (31 percent) already had glasses; only 19 boys out of the 1,129 failed the plus-1.50 test so we may assume that the majority who were wearing glasses were doing so because of myopia or astigmatism. With this in mind, a referral figure of 30 percent does not seem excessive.

TABLE 1

Visual acuity without glasses

1,129 different male adolescents ranging from 13 to 19 years of age

	O.D.		O.S.		O.U.	
	Number of Cases	Percent of Cases	Number of Cases	Percent of Cases	Number of Cases	Percent of Cases
20/ 20	681	60.3	724	64.1	811	72.0
20/ 25	92	8.2	79	7.0	50	4.4
20/ 30	54	4.8	37	3.3	25	2.2
20/ 40	45	4.0	38	3.3	37	3.3
20/ 50	32	3.0	33	3.0	36	3.2
20/ 70	36	3.2	41	3.6	30	2.6
20/100	57	5.0	43	3.8	44	3.9
20/200	83	7.3	87	7.7	65	5.8
20/200 plus	48	4.2	47	4.2	30	2.6
Eye absent	1	0.09	0	0	1	0.09
Total	1,129	100.09	1,129	100.0	1,129	100.09

It is generally believed that the visual acuity rating obtained in a school vision-testing program tends to be lower than that subsequently found by the eye specialist. This is probably due to the poorer illumination of the school charts, the poorer condition of the school charts, the fact that the school examiner is more pressed for time and also tends to give a line-lower rating in case of any doubt than does the specialist.

These factors did not operate in a significant degree in the testing described here and,

therefore, it is possible that a considerably higher percentage of these students would have failed the 20/30 line had the tests been done in the usual sort of school situation. If this is true, it might be well to consider failure of the 20/40 line the proper level for referral in school screening test rather than the 20/30 line; on this basis about 18 percent would be referred.

Hypermetropia

The presence of hypermetropia was determined by instructing the examinee to attempt to read the 20/20 line on the Snellen chart through a pair of plus 1.5D. sph. Ability to read this line with either or both eyes was scored as a failure.

In a previous study of 797 boys[5] there were 518 who did not wear glasses; 36 of these (6.9 percent) had 20/20 vision in one or both eyes through plus 1.5D. sph. and were therefore rated as failing the test for hypermetropia.

Another group,[6] similarly tested, showed that 10 percent of 466 boys who did not have glasses failed this test. The significance of the data relating to this group is no more than an indication of the number of failures this test may produce when members of this age group and socio-economic level are examined. There were only about two percent of the 779 who did not have glasses who failed this test. A considerable number of the 350 who already had glasses undoubtedly had hypermetropia, but these data do not permit an estimate of what that number might be. In a similar series 16 out of 62 boys who were wearing glasses at the time of their first screening examination were known to be wearing them because of hyperopia, hypermetropic astigmatism, and so forth. On the basis of that small series, one might expect to find that about 25 percent of such a group wear glasses because of some type to hypermetropia.

TABLE 2

Distribution of hyperphoria measurements
Glasses were worn by the 350 individuals who owned them

Prism Diopters	Number Tested without Glasses	Number Tested with Glasses	Total Number Tested
Right hyperphoria			
5	1	2	3
4	0	1	1
3	1	1	2
2	2	1	3
1	22	15	37
Left hyperphoria			
5	2	1	3
4	0	0	0
3	0	1	1
2	3	3	6
1	7	15	22
Unable to do	3	2	5
Orthophoria	738	308	1,046
Total	779	350	1,129

Measurements for heterophoria (distant) were determined at 20 feet. The subject viewed letters and numbers which formed a Maddox cross and a one centimeter light through spectacles in one pair of which a red multiple Maddox rod was mounted horizontally for the right eye and in the other pair of which a red multiple Maddox rod was mounted vertically for the right eye.[9] The examinee wore his own glasses under these spectacles if he had glasses.

Hyperphoria

Table 2 gives the distribution of Maddox-rod measurements. Five boys were unable to give a response which could be interpreted and 19 (1.69 percent) had more than one prism diopter of hyperphoria. These figures are similar to those in two other surveys[5,6] utilizing the same test, which reported more than one prism diopter of hyperphoria in 1.5 percent out of 797 boys in one group, and 2.5 percent in the other group of 715 boys.

Esophoria—Exophoria (distance)

Only 1.2 percent of this group were found to have more than six prism diopters of esophoria (distance) with the Maddox-rod test; 1.9 percent had more than four prism diopters of exophoria (table 3). This total of 3.1 percent having an excess of the standards[9] set for esophoria and exophoria (distance) is similar to the finding of 3.1 percent and 5.7 percent in two other groups.[5,6]

In a study[13] of 100 candidates for submarine school, two individuals were found to have more than six diopters of esophoria and one had more than four diopters exophoria (distance). A phorometer with Risley prisms and Maddox rods was used and a one-centimeter light was viewed without glasses at 20 feet.

Esophoria—Exophoria (near)

Heterophoria for near vision was measured by use of a calibrated card held at 16 inches and viewed through 3.0D. prisms mounted base-up for the right eye and base-down for the left eye.[9]

A total of 22 (two percent of the group) boys failed to meet the standards set for this test; about 0.5 percent of the 1,129 boys in this group were found to have more than six diopters of esophoria (near) and 1.5 percent to have more than eight diopters exophoria, near (table 4). Twenty out of 797 boys in another group (2.5 percent) tested in the same manner[9] had more than six diopters esophoria or more than eight diopters exophoria; in another similar survey[6] of 715 boys, 2.7 percent exceeded those degrees of heterophoria. In the study of submarine candidates,[13] the subject's gaze was directed at the light bulb of an ophthalmoscope fixed at eye level at 13-inches distance and attached to a phorometer.

With these three methods, and a re-test of each, the number exceeding six diopters of esophoria varied from zero to three percent and those exceeding eight diopters exophoria varied from 15 to 34 percent. The variability of heterophoria tests both in amount and kind is well known;[14] that these data show as much similarity as they do (except in the

TABLE 3

Distribution of esophoria and exophoria measurements at distance

Glasses were worn by the 350 individuals who owned them

Prism Diopters	Number Tested without Glasses	Number Tested with Glasses	Total Number Tested
Esophoria			
1	157	36	193
2	70	27	97
3	34	12	46
4	12	4	16
5	6	5	11
6	7	4	11
7	6	0	6
8	0	2	2
9	3	3	6
10 or more	0	0	0
Exophoria			
1	57	31	88
2	16	11	27
3	8	10	18
4	3	3	6
5	2	3	5
6	2	2	4
7	2	3	5
8	1	1	2
9	3	3	6
10 or more	0	0	0
Unable to do	2	3	5
Orthophoria	388	187	575
Total	779	350	1,129

TABLE 4

Distribution of esophoria and exophoria measurements (near)

Glasses were worn by the 350 individuals who owned them

Prism Diopters	Number Tested without Glasses	Number Tested with Glasses	Total Number Tested
Esophoria			
1	70	42	112
2	32	19	51
3	16	3	19
4	7	8	15
5	10	1	11
6	3	0	3
7	2	2	4
8	0	0	0
9	0	0	0
10	1	0	1
11	0	0	0
12	0	0	0
13	0	1	1
13 plus	0	0	0
Exophoria			
1	88	37	125
2	39	15	54
3	24	9	33
4	6	3	9
5	12	7	19
6	4	4	8
7	10	5	15
8	5	5	10
9	2	2	4
10	4	3	7
11	1	0	1
12	0	0	0
13	3	1	4
13 plus	0	0	0
Unable to do	8	17	25
Orthophoria	432	166	598
Total	779	350	1,129

instance of the submarine candidates' exophoria at near) is surprising and suggests that the results are reasonably reliable.

The desirability of including tests for heterophoria has been reported[9]. In that survey, 25 boys out of a group of 518 who did not have glasses failed these tests but passed the tests for visual acuity and hypermetropia.

Summary

1. One obstacle in the development and use of proper visual-screening tests in schools and industry has been the difficulty of determining normal (or, better, optimal) limits for the findings each test produces. This report provides the distribution of various test results at the vision examination of 1,129 boys ranging in age from 13 to 19 years. The vision examination was part of these adolescents' annual health examination and the screening method used was a modification of the Massachusetts Vision Test.

2. About 72 percent of this group had 20/20 naked binocular vision.

3. If the basis for referral was set at failure to read the 20/30 line with one eye, the usual acuity test would have selected about 25 percent; if the basis was failure to read 20/30 with both eyes, about 21 percent; if the basis was failure to read the 20/40 line with both eyes, 18 percent would be referred to a specialist.

4. The test for hypermetropia was done with glasses, if the subject had them; 350 members of this group already had glasses. Two percent of those who did not have glasses (779) failed this test.

5. More than one prism diopter of hyperphoria was found in 1.69 percent; more than six prism diopters of esophoria in 1.2 percent; more than four prism diopters exophoria in 3.2 percent. At near there was more than six prism diopters esophoria in 0.5 percent and more than eight prism diopters exophoria in 1.5 percent.

6. Attention is called to the desirability of including tests for hypermetropia and heterophoria as well as for visual acuity in any screening method.

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STIMULUS-RESPONSE MECHANISMS IN BINOCULAR COÖRDINATION*

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Ever since a serious study of binocular coördination was launched by Donders, the emphasis in the study of that subject has been upon the anatomic factors and upon the end results of the coördinated movements. Little has been done, for example, in working out the physiologic and psychologic processes which are the fundamental factors in most orthoptic procedures. In this essay I shall present a consideration of binocular coördination from the viewpoint of the reflex arcs or stimulus-response mechanisms which are involved.

In spite of the very considerable increase in our knowledge of the anatomy of the nervous system and of the details of structure of the extraocular muscles, we have not yet reached the point where that knowledge can be used practically in the solution of the problems of binocular incoördination, except where surgery substitutes an anatomic abnormality for a physiologic dysfunction. This discussion is not concerned with these latter cases.

Every movement of the body, and, for that matter, every thought process, is the result of a suitable stimulus transmitted through many synapses and interconnecting neurons, and culminating, respectively, in muscular movement or in a concept, or both. In the responses of accommodation and convergence, which are essentially muscular responses to contractile innervation which, in turn, must be the result of the operation of adequate reflex arcs, we may inquire what are the primary stimuli which initiate these reactions.

Most of our present-day terminology is based entirely upon the response itself and does not consider the stimulus which produces it. For example, we might consider the concept of convergence insufficiency, which is based entirely upon the relationship between the kind and amount of heterophoria present during fixation for distance and that found when the fixation object is at a near point.

Experience demonstrated, however, that "convergence insufficiency" is not always an insufficiency, and the further concept of the convergence near point had to be introduced. It is not at all uncommon to find a case of so-called convergence insufficiency which has a convergence near point of four centimeters. Evidently no actual lack of convergence is present in such a case.

The concept of convergence excess may be questioned on similar grounds, as can also the other two possible deficiencies which may be present in this system of classification, divergence excess and divergence insufficiency. Such a classification, although widely used, is adequate neither for descriptive purposes nor as a basis for the application of suitable corrective therapy. Let us consider the abnormalities described by the above terms in the light of the deficiencies in the stimulus-response mechanisms which produce them.

Faulty binocular coördination, manifested by an abnormal position of the visual axes of the two eyes or by a compensated tendency toward actual malposition of the axes, has been a major concern of ophthalmologists for many years. While the basic reason for its existence may be uncertain in many cases, it is widely appreciated, however, that actual anatomic anomalies, such as faulty insertion or improper length of the individual muscle, are met with very rarely, and that the usual basis of nonparalytic faulty binocular coördination is innervational.

Long before much was known about

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muscle tonus, the basic position of the visual axes, when binocular vision was abolished and accommodation eliminated, was described as the tonic position of the eyes, and any deviation from parallelism under such conditions was designated as positive or negative tonic convergence.

Sheard,[1] in 1917, presented a summation of previous work in this field, together with the results of his own experiments, and demonstrated that heteronomous or nonconjugate lateral movements of the eyes, constituting what is usually designated as either convergence or divergence, are, in nonparalytic cases, the result of certain initial stimuli, for which the vergence movement is the response. If this concept is applied to all vergence reactions, it should be possible to determine the sources of the stimuli which would produce such action.

In later years, Chavasse[2] has added much to these concepts and has been instrumental, through his revision of Worth's text, in modifying much of the ophthalmic thought in this field.

I[3] have continued and amplified this viewpoint, as it seemed to offer a more practical way to approach the immediate problems of heterophoria and heterotropia than that afforded at present by neuro-anatomic and neuro-physiologic methods.

Sheard[4] considered that the vergence reflexes were three in number; those due, respectively, to (1) the normal tonic innervation from the tonic centers in the brain stem; (2) to the influence of the fusion mechanisms as a result of the desire for single binocular vision; and (3) to the action of accommodation. These were designated the tonic vergence reflex, fusional vergence, and accommodative convergence, respectively.

Subsequent work has demonstrated the existence of a fourth reflex in convergence, that which is stimulated by the sense of nearness of the object of regard, the so-called proximal convergence reflex. It has been found possible to classify all binocular abnormalities in terms of a faulty functioning of one of these four fundamental stimulus-response mechanisms.

Tonic vergence

It is well known that the extraocular muscles, like all other muscles of the body, have a relatively small, but constant, tension which is the result of an ever-present contractile innervation from the subcortical tonic center. The tone of a muscle, as manifested by its constant tension, is apparently quite independent of its position or degree of contraction, provided there is no change in its load, and the extraocular muscles seem to form no exception to this general rule. They are anatomically quite powerful when compared with the actual force needed to move the eye.

Ocular movements are ordinarily quite precise, the accuracy required in fixation demanding a very fine degree of control of the innervation to the muscles, and this can be accomplished only if the tonic innervation is distributed efficiently to each of the six muscles of the eye. The precise mechanism of this distribution is not well known, but the work of Sherrington[5] and his many successors has shown, rather conclusively, that the distribution of motor stimuli to the extraocular muscles, in an ocular system without anatomic or pathologic deficiencies, is according to the principles of reciprocal innervation and inhibition.

In binocular coördination, a somewhat higher and more complex association is that between the individual reciprocal innervation systems of the two eyes, and the net result, as manifested by the angular relationship between the visual axes of the two eyes, is designated the tonic vergence when all sources of innervation, other than those modifying the basic tone of the muscles, are eliminated.

Tonic vergence may be defined, therefore, as that angular relationship of the two visual axes which is present when the only source of innervation to the extraocular muscles is the tonic center, unmodified by accommoda-

tional, fusional, or proximal stimuli. It is that heterophoric or constant heterotropic condition found by subjective dissociation tests or objective cover tests during fixation at distance, with accommodation suppressed. Tonic vergence, however, is not a simple entity. Adler,[6] in a recent paper, has discussed the several reflex sources of modification of the tone of the extraocular muscles, and has shown that the principal ones are:

1. Static reflexes: (a) Stretch reflexes from neck muscles; (b) otolith reflexes.

2. Statokinetic reflexes: (a) Semicircular canals (in movement); (b) specialized proprioceptive sense of ocular muscles.

To these I should like to add those concerned with binocular vision:

3. Visual fixation reflexes: (a) Conjugate movements; (b) vergence movements.

4. Association reflexes: (a) Accommodative; (b) proximal.

The modifications in tone discussed by Adler are mainly those concerned with maintaining accurate and efficient associated movements of the eyes. They are concerned with modifications in the level of tone of the various muscles in order to produce movement but, after the necessary movements for fixation have been accomplished, the actual tonic innervation to the muscle in its new position probably differs but little, if at all, from that which was present in the original position, if the movement has been within 35 degrees from the primary "eyes front" position. Movements of greater extent probably result in "loading" one or more of the extraocular muscles because of the beginning resistance of the orbital structures to further turning of the eye.

It is necessary to keep in mind that an accurate determination of heterophoria is not possible unless all the primary sources of tone are present and functioning. If, either intentionally or unintentionally, afferent impulses are prevented from exerting their full influence in the integrative process in the tonic center, the resultant heterophoria will differ to a greater or lesser extent from that which would be present if the influence of all of the stimulus sources were properly represented. This is the Gestalt principle and means, in effect, that, if a reflex situation is broken up into its component parts, the reflex is no longer a unit and the sum of its parts no longer equals the whole.

Applied to the tonic vergence procedures and findings, the foregoing would suggest that the heterophoric values found during any type of test procedure are fundamentally inaccurate in that one of the major sources of tone, the fusional mechanism, is not effective because of the fusional dissociation necessary for the measurement. Apparently, however, some time is required for the absence of this factor to have its full effect, and the progressive nature of the process is probably best demonstrated in the subjective screen parallax test, where it may take 15 or 20 minutes, in some instances, for the heterophoria finally to settle down to a value which differs perhaps several prism dioptries from that found at the beginning of the test.

Marlow[7] demonstrates this factor very well with his experiments upon prolonged occlusion. That the final heterophoria in most of his cases differed markedly from that originally found before the occlusion process is only to be expected when interpreted in the light of the Gestalt principle, inasmuch as he had eliminated for a considerable time one of the original sources of tone.

From the clinical standpoint, therefore, the results of the heterophoria tests probably best demonstrate the actual values when the tests are carried through as rapidly as possible.

Where no anatomic abnormality, paralysis, or paresis of the individual muscles exist (and this includes all orthophoric, all heterophoric, and most heterotropic cases), binocular imbalances probably are due entirely to faulty tonic innervation or to the lack of a suitable modification of the basic tonic reciprocal innervation by fusional, accommodational, or proximal stimuli.

While experimental work with animals is possible and informative in the study of reciprocal innervation of single eyes, it is not helpful, for the most part, in the study of binocular incoördinations, first, because few animals have binocular vision even approaching the human type, and, second, because subjective reports are necessary to establish visual achievement and the presence or absence of single binocular vision.

Studies of individuals

Either statistical surveys or intensive studies of individuals, then, must be the types of research useful in this field. An example of the first type of approach is that described in the following paragraphs:

In order to study the effect of modifying the reciprocal innervation of the extraocular muscles with different degrees of contraction of each of them, 500 subjects were tested, of whom about one half were college and medical students, and the balance a non-selected group of clinic and private patients. Each of the subjects had been refracted within the previous year and wore a suitable lens correction, if needed, thus reducing any accommodational factors to a minimum.

The ocular motility of each subject was observed by the use of the alternate screen test in each of the six cardinal positions. Only those subjects were utilized who had binocular vision and exhibited no individual muscle weakness. Each subject was then examined with the aid of a phorometer, utilizing, as an object, a single 6/30 illuminated test letter at six meters. The lateral binocular balance was ascertained by the use of a 6$^{\Delta}$ dissociating prism base-down over the right eye, and the lining up of the diplopic images by means of a base-in or base-out rotary prism over the other eye.

The phorometer was so arranged that the lateral heterophoria, or lack of it, could be ascertained in the "eyes front" position, and then with the head turned to the right 30°, to the left 30°, up 30°, and down 30°. The accuracy of the head position was assured by the use of a wooden 30-degree triangle, one side of which was aligned along the plane of the lenses, and the other along the line joining the apices of the corneas of the two eyes.

In this whole series of subjects there were only three who showed more than 2$^{\Delta}$ of variation in any of the five head positions, despite the fact that in each of these positions each of the 12 extraocular muscles was in a different state of contraction or extension.

In general, the results of this simple experiment tend, along with the previous work already summarized, to demonstrate that tonic innervation to the extraocular muscles is distributed in each eye according to the principles of reciprocal innervation, and, further, that there is a central subcortical control of the two individual reciprocal systems which keeps the relationship of the visual axes practically constant for positions of the eye which do not exceed the limits of easy rotatability. This is, of course, the general principle of comitant movement of the eyes.

In addition to these experimental observations, I have observed many clinical cases, over periods up to 20 years, and have been impressed by the fact that the tonic-vergence (heterophoria) values for distance tend to change but little in the average individual during the two or three years elapsing between routine refractions. Any substantial change generally indicated the development of a single muscle weakness, which could usually be demonstrated by a screen test in the cardinal positions.

In the course of the experiments described in this paper, the variability of the results was affected in some cases when different stimulus conditions were used. This, however, should be expected, as in any experimental work involving stimulus-response mechanisms, a variation of the stimulus conditions usually will produce some change in the response. This factor was recognized in the work with tonic vergence, and the difference between the results of the two general

types of dissociation were tabulated.

Dissociation of fusional effort in binocular vision may be obtained either by placing the retinal image of one eye beyond the range of fusional correction, as had been done in the experiment above, or by altering the form and color of the two images, thus making them entirely dissimilar, as is the case when a multiple Maddox rod is placed over one eye and a red glass over the other. A careful comparison of the two methods made during the course of this experiment, however, revealed only minor, and statistically nonsignificant, differences if accommodational and proximal stimuli were ruled out.

Of those which showed some variation, it is noteworthy that it was toward the esophoric condition when the Maddox rod and red light were used for dissociation. This suggests that the relative indistinctness of the small test light, as modified by these appliances, served as a stimulus for accommodation in these few cases.

Summing up the general subject of tonic vergence, it would seem that (1) regardless of the many sources of the stimuli affecting the tonic innervation of the extraocular muscles, the latter seems to be quite constant for different positions of the eyes with distance fixation, when the individual is awake and conscious, and not under the influence of alcohol or drugs; and (2) that it varies very little from time to time, provided accommodational influences are eliminated.

Fusional vergence

So far, only those factors which are operative in the purely associated movements of the eyes have been considered. When the fixation point is within infinity, however, the visual axes must converge in order that the images of the object of regard will remain upon the two maculas. Such movements are accomplished by heteronomous movements of the eyes on the lateral plane, which can be considered as convergent or relative divergent movements resulting from modifications in the distribution of tonic reciprocal innervation to the 12 extraocular muscles concerned. This modification of basic innervational distribution seems to be accomplished by stimuli arising from the fusional, accommodational, and proximal sources.

Fusion is properly considered to be not only the anatomic and physiologic arrangement which permits the superimposition in the visual cortex of the sensory impulses arising in the two retinas, thus making possible single binocular vision and stereopsis, but also as the stimulus-response mechanism whose duty it is to keep the object of regard on the proper corresponding retinal points by means of reflex control of the extraocular muscles.

The first function of fusion, as outlined above, is concerned entirely with sensory perception and is that which should properly be designated as fusion. The second function of the fusion mechanism, that of varying the position of the eyes in order to retain binocular vision, will be considered as fusional vergence. While these two functions are interrelated and interdependent, we shall consider only the second.

Fusional vergence may be defined, therefore, as the modification produced by the fusional processes in the distribution of tonic reciprocal innervation to the extraocular muscles in order to gain or maintain single binocular vision when the individual is not orthophoric for the fixation point.

In the past, fusional vergence has been variously named fusional convergence, positive and negative adduction, abduction, prism convergence and divergence, ability to overcome prism, and prism vergence.

The general term, fusional vergence, is probably the most convenient and precise, although, for amplitude testing, the terms prism convergence, prism divergence, and prism hyper- and hypovergence are useful.

As will be seen subsequently, the fusional vergence amplitude and the results of the fusional vergence tests are identical only when the subject is orthophoric for distance fixation.

STATISTICAL INVESTIGATION

A typical statistical investigation in this field is that described in the following paragraphs:

In the series of procedures used in the experiment, the object was a 6/30 "E," black on translucent glass base, and illuminated from behind with an illumination equal to 10 foot-candles at the plane of the letter.

Prism values were supplied by means of the Risley prisms in a standard DeZeng phorometer. In the fusional vergence test, prisms were increased before each eye simultaneously, making an effort to keep the increase of the prism power equally distributed between the two eyes and with a suitable lens correction before each eye, so that accommodational factors were eliminated or reduced to a minimum.

The fusional convergence was determined by introducing prism base-out (prism convergence) before each eye and increasing the values equally until diplopia occurred. The sum of the value of the two prisms just before the second image appeared was recorded. The same procedure was carried through with prism base-in, and represents the fusional divergence (prism divergence).

After the fusional vergence had been determined in either direction, the prism power was equally and slowly reduced before each eye, and the subject directed to report as soon as he again had single binocular vision. The prism value at this point was noted and was tabulated as a reversion to fusion value.

It will be noted, in passing, that a somewhat similar method can be used to determine sursumduction, and these values can be used in the determination of the extent of the extramacular fusion area in the vertical directions.

In order to obtain the actual amplitude of the fusional vergence and the reversion to fusion in other than orthophoric individuals, it was necessary to deduct, or add, the value of the tonic vergence to the fusional vergence reserve findings. In esophoria, for example, part of the convergence found by a prism base-out procedure would be due to the tonic convergence anomaly, and the actual influence of fusion in turning the eyes inward would be measured by deducting the amount of esophoria for distance from the positive fusional convergence reserve (prism convergence).

Thus, if the tonic convergence findings in a given subject were 3^{Δ} of esophoria, and the prism convergence 20^{Δ}, it is evident that the fusional convergence would be responsible for only 17^{Δ} of the total found in the adduction procedure, as the eyes, under cover, would deviate inward to the extent of 3^{Δ}, and thus have that much start before the fusion mechanism stimulated further convergence.

If the subject were exophoric, however, the value of the prism convergence would have to be increased by the amount of the exophoria, in order to determine the actual amplitude of the fusional convergence.

It is always necessary to remember, in using definite numerical values such as those just described, that the values are subject to some variations due to clinical limits of error, observational variations, and slight changes in tone. They should always be read as "of the order of."

In the analysis of the data obtained in this experiment, it was noted that the curve of distribution was broad, with a fairly large representation of the extremes of value. This suggests that there is a learning element in the fusional vergence mechanisms, and this fact is borne out by the increased values, especially in the fusional convergence amplitude, which many have found can be attained by orthoptic exercises.

From the standpoint of the stimulus-response mechanisms in fusional vergence, it would seem that, in the amplitude determinations, the response of the extraocular muscles is dependent primarily upon the stimulation of receptors which immediately encircle the macular area. If, in distance fixation, one eye tends to deviate from the object of regard as a result of the presence of a

tonic vergence abnormality for that fixation, these perimacular receptors are stimulated by the image edging over from the macular area, and as a consequence of a probably complex associative linking, the tone of the extraocular muscles is momentarily modified, the eye turned, and the image returned to the macula.

When diplopia has been established as a result of further introduction of prisms, and the prism power is being reduced in order to measure the reversal to fusion amplitude, the subject is fixing the stimulus object with the macula of one eye, and in the other eye the retinal image is in one of the peripheral fields.

As the prism power is gradually reduced, the image in the nonfixing eye approaches closer and closer to the macula until it finally reaches a point in the peripheral retina where the number of sensitized receptors is great enough to actuate the fusional vergence reflex, with the result that the tone of the extraocular muscles is immediately and momentarily modified, the eye shifted for macular perception, and single binocular vision regained. Thus, it becomes possible to plot, in a given individual, the area on each retina within which images must fall, if there is to be single binocular vision.

This area has been termed by me[8] the extramacular fusion area, while the zone immediately surrounding the macula, the stimulation of which provides the fusional vergence amplitude, may be called the perimacular fusion area.

Disregarding the higher centers and tracts concerned in these reflexes, we may consider the peri- and extramacular receptors, and the ocular movements which result from their excitation, as the essential parts of the stimulus-response mechanism which is charged with the maintenance of single binocular vision.

As far as the retinal receptors are concerned, it is uncertain whether those effective in the fusional vergence reflex are rods or cones, or both, and for the present purpose it is immaterial, although the greater number in the perimacular area, as compared to the lesser number in the periphery, and the fact that the process is intimately concerned with central vision, would suggest that the receptors are probably cones.

Accommodative convergence

Accommodative convergence is that convergence or lessened divergence which results from accommodative activity reflexedly superseding the underlying tonic reciprocal innervation. Accommodative convergence is present only when the fusional vergence has been destroyed by some dissociation process and the eyes are free to converge as a result of accommodative stimulation. It is a type of association reflex and is dependent entirely upon the extent to which the association between the accommodation and convergence is developed.

I have found it to be present in children three years of age, and have deduced its presence in still younger children. Because there seems to be no effective coördination of the ocular movements with vision for some time after birth, however, it is probable that this reflex does not begin to develop until the latter part of the first year or early in the second year of life. During this period, the child is using a considerable amount of accommodation because of the high hyperopia which is characteristic of his age group, and, at the same time, tends to hold objects rather closely, thus requiring a considerable amount of convergence if single binocular vision is to be had.

While, as we have seen, the fusional convergence effectively supersedes the tonic vergence reflex in order to provide for this near fixation, the simultaneous and constantly repeated use of accommodation and convergence usually tends to associate the two, so that the presence of the one will serve as a stimulus to the other if the second has not already been stimulated by fixation and is thus free to respond.

It is possible, for instance, to suppress

the fusional vergence reflex by placing a red glass over one eye and a Maddox rod in front of the other one, and then measure, under these conditions, both the tonic vergence and, if accommodation be then induced for distance by the use of concave lenses, the departure from the basic tonic vergence which is due to the use of accommodation. A 6$^{\Delta}$ or 8$^{\Delta}$ prism base-down over one eye or divided between the two eyes, base-up in one and base-down in the other, is also an excellent method of destroying the fusional vergence reflex.

Under such conditions, accommodative convergence can readily be measured by subtracting algebraically the lateral heterophoria for distance from the near point heterophoria value, which gives the physiologic esophoria or exophoria. This value, in turn, subtracted from the total convergence from parallelism to the near point (usually 18°) gives the accommodative convergence found under the given conditions.

A carefully conducted statistical survey of several thousand cases, in which the near-point accommodation was for a fixation of one-third meter, showed a fairly typical Gaussian distribution curve such as that which would be found if a similar group were tested for any type of learned response. The usual values are from zero to 20$^{\Delta}$ of accommodative convergence, although in a very few cases the latter amount was exceeded, with the great majority of individuals exhibiting between 6$^{\Delta}$ and 14$^{\Delta}$.

The influence of accommodational variations on convergence can be studied by determining the amount of accommodative convergence for various levels of accommodation. A typical experiment of this type is the following:

Wearing an adequate lens correction, a subject with 60-mm. pupillary distance has orthophoria for distance fixation and 6$^{\Delta}$ of exophoria at 33 cm., thus presenting 6$^{\Delta}$ of physiologic exophoria and 12$^{\Delta}$ of accommodative convergence. The latter value demonstrates an average good associative reflex relationship between accommodation and convergence.

Fixing at distance with a 6$^{\Delta}$ base-down dissociating prism in place before one eye, a −1.0D. lens was placed before each eye and the patient encouraged to see clearly the fixation letter at six meters. To do so he accommodated 1.0D. with each eye and the heterophoria test then revealed 2$^{\Delta}$ of esophoria. A further increase of concave lens value gave more esophoria as follows:

Subject Lens	Added	
Rx. only	None	= Orthophoria
Rx. with	−1.0D.	= 2$^{\Delta}$ Esophoria
Rx. with	−2.0D.	= 5$^{\Delta}$ Esophoria
Rx. with	−3.0D.	= 8$^{\Delta}$ Esophoria

In this experiment, the only change in the stimulus conditions was the increasing value of the concave lenses, and the consequent increased accommodation necessary to retain good vision. The existence and character of the accommodative convergence reflex was thus demonstrated in this subject.

It must be borne in mind, however, that the accommodative convergence reflex is operative only when the accommodation is made the dominant factor by the removal of fusional vergence. There is every reason to believe that under normal conditions of fixation, in which accommodation is functioning primarily because of the desire to see clearly, and where the convergence is supplied primarily by fusional convergence due to the repugnance of the organism to diplopia, the accommodative convergence reflex, and also its fellow associated reflex, that of convergence accommodation, are not operative.

An appreciation of the character of accommodative convergence as a learned association reflex will serve to explain the great range of accommodative convergence values which is found clinically. A total absence of the accommodative convergence reflex is not an abnormality, nor is a slight excess above the usual average limit a serious fault. The reflex may have some physiologic significance, however, for the presence of only a small amount of accommodative conver-

gence may tend to slow up the process of adjusting the eyes for a given fixation, while an exaggerated response very often indicates an abnormally responsive or irritable central nervous system.

Proximal convergence

Proximal convergence is an association reflex of the same type as accommodative convergence, except that its primary stimulus is the sense of nearness, or proximal sense, rather than the use of accommodation. While the stimulus factor in this type of convergence is less definite than in tonic or fusional vergence, or in accommodative convergence, there can be little doubt as to its existence. I have recently investigated its character and values and have found that the distribution in a considerable number of experimental subjects was typical of that encountered in any learned response. For practical purposes, however, there is no objection to considering that the proximal convergence is superseded by the accommodative convergence in cases in which there is some of the latter.

Proximal convergence can also be demonstrated and measured without great difficulty. In order to do so, it is necessary to destroy the fusional vergence and the accommodative convergence reflexes, because these are usually so considerably greater in amount that the proximal reflex is superseded when either is present.

With fixation at near, dissociation to destroy the fusional vergence reflex, and sufficient lens power in place to relieve accommodation, any positive convergence, other than that which is present in the tonic vergence balance at distance, represents the proximal stimulatory effect on the convergence mechanism. Removal of the stimulus to a greater distance, keeping the reflexes under control, will reduce the convergence ultimately to the tonic level.

Diagnostic principles

It may now be of interest to consider the application of these principles in the diagnosis of nonparalytic ocular incoördinations. It becomes evident that heterophoria or comitant heterotropia for distance, if fusional, accommodative, and proximal stimuli are eliminated, must be due to deficiencies in the distribution of tonic reciprocal innervation. Long experience has shown that these tonic vergence deficiencies, as a rule, can be changed only slightly by any exercise method.

At the near point, esophoria, or considerable exophoria, in heterophoric cases depends either upon heterophoria for distance fixation, which is a tonic vergence deficiency, or upon variations in the amplitude of the accommodative convergence reflex. In the former case, we must be careful not to place the blame upon accommodational variations, and, in the latter case, the matter is of no importance if the accommodative convergence reflex is below the usual value, as it will be when much exophoria for near is present. Accommodative convergence anomalies become significant only when they are excessive, producing an esophoria at near.

It is possible, therefore, by the application of these stimulus-response concepts, to make a useful diagnostic classification for any type of heterophoria or for comitant heterotropia. The deficiency will be due to one or more of the following:

1. Abnormal tonic vergence, due to wrongly distributed tonic reciprocal innervation to the extraocular muscles and manifested by heterophoria for distance fixation when accommodational and proximal influences are absent.

2. Deficiencies in the amplitude of fusional vergence. Physiologically, this represents an inadequate number of perimacular fusional receptors, or, more likely, a lack of adequate development of the remainder of the stimulus-response arc, in which the perimacular receptors initiate the stimulus, with the response represented by a modification of the reciprocal innervation to the extraocular muscles.

3. Excessive accommodative convergence. In these cases, the associatively developed accommodative convergence reflex has replaced the basic tonic vergence reflex as that which must be modified and controlled by the fusional vergence reflexes. As a rule, this condition is manifested only at the near point, and the reflex may be controlled adequately, if temporarily, by the prescription of added convex lens power in the form of bifocals.

Orthoptics

In my opinion, the most rewarding field in orthoptics is its use in those cases where visual discomfort is due to heterophoria. Single binocular vision is present in such cases, but there is difficulty in keeping the visual axes directed comfortably and efficiently upon the object of regard. In esophoria, exophoria, or cyclophoria, the fusional vergence mechanisms which are functioning, although very inadequately sometimes, are usually responsive to orthoptic procedures designed to increase the amplitudes of fusional vergence in the direction opposite to the deficiency.

The orthoptic approach to the correction of heterotropic abnormalities is not generally so successful, except in the cases of accommodative convergent squint. Most of the squints which are due to deficiencies in tonic vergence will ultimately require surgery preceded and followed by orthoptic procedures.

All orthoptic procedures, whether used for heterophoria or heterotropia, and designed to affect the innervation to the extraocular muscles, may be classified in one or two major groups, according to the method of approach, the physiologic and the psychologic, and are, in themselves, stimulus-response processes.

Procedures which consist of rotation exercises, whether it be with monocular or binocular fixation, can accomplish only a smoother, more even, and more precise distribution of reciprocal innervation to the extraocular muscles, and so may be considered as purely physiologic in character. Such exercises are of no direct help in the development of fusion and fusional vergence, except insofar as they promote precision and accuracy in fixation and make the muscles more delicately responsive to the motor impulses which come to them.

This, of course, is the general principle behind all coördination procedures for opposing muscle groups elsewhere in the body. In the minor binocular balance difficulties occasionally encountered when new lens prescriptions have been given, this type of exercise seems to be quite helpful, as it very often also is in borderline fusional vergence deficiencies, where it apparently increases the efficiency of the fusional vergence reflex just enough to bring binocular vision within a comfortable zone.

The second of the two major approaches in orthoptics is that which may be termed psychologic, in that it involves not only sensory fusion, but the operation of a learned reflex which is dependent upon fusion, the fusional vergence reflex.

All work with binocular vision, aside from that concerned only with sensory fusion, and involving the use of a stereoscope or its many modifications, such as the amblyoscope, the synoptophore, the troposcope, the telebinocular, and all similar appliances, may be considered as belonging to this classification, and has only one object, the inception or the increase of the fusional vergence reflex so that its amplitude is adequate for the maintenance of single binocular vision.

In all heterophoric problems, the amount of the heterophoria may be compared with the amplitude of fusional vergence available to neutralize it and both expressed in a use-amplitude fraction, in which the numerator represents the tonic vergence deficiency (heterophoria for distance) and the denominator the amplitude of fusional vergence in the opposite direction.

For example, an individual who presents 5^{Δ} of exophoria for distance may have only 8^{Δ} of prism convergence for the same fixation. His total amplitude of fusional con-

vergence under the test conditions is $5^{\Delta} + 8^{\Delta}$ or 13^{Δ}, of which 5^{Δ} must be used constantly. This means that the temporal perimacular fusional receptors must be stimulated constantly to produce at least 5^{Δ} of fusional convergence to neutralize his exophoria. The use-amplitude fraction is thus 5/13 or slightly less than one half.

Experience has demonstrated repeatedly that the average healthy person has difficulty in using more than one fourth to one third of his amplitude of fusional vergence constantly for distance, so that this patient is probably uncomfortable.

Because any attempt to lessen the exophoria is usually ineffective, the only practical approach is to increase the fusional convergence amplitude, fortunately a relatively easy task in most cases. If, in the case just described, the prism convergence is increased by suitable exercises to 30^{Δ}, for example, the use-amplitude fraction becomes 5/35 and the patient is probably comfortable.

To accomplish this, stereoscopic instruments may be used with identical bidimensional or with tridimensional stimuli and the angles between the visual axes varied repeatedly by techniques which are familiar to the orthoptist. Home-exercise procedures with prism bars or other simple apparatus also are usually quite effective in increasing the amplitude of fusional convergence.

As previously pointed out, these procedures rarely result in any appreciable change in the actual amount of heterophoria, but they may so increase the fusional vergence amplitude in the direction opposite to the heterophoria that the patient may be able to have his tonic vergence inadequacy constantly neutralized without discomfort.

The orthoptic treatment of amblyopia and visual suppression, and the development of sensory fusion are, of course, also to be considered as belonging in the psychologic group, but do not come within the scope of this paper.

Orthoptic exercises, of whatever kind, are essentially learning procedures in which the stimulus-response mechanisms are initiated or rendered more efficient. As such, orthoptic procedures can be efficient only when they are applied in accordance with the principles of learning which are well understood in physiologic and pedagogic circles, but which are much less familiar to refractionists and orthoptists generally.

For any sort of learning, there must be a fundamental ability based upon the presence of suitable anatomic arrangements in the nervous system, that is, a certain response to a given stimulus must be physiologically possible. In the absence of anatomic abnormalities which interfere with the physiologic processes, the following five laws of learning will apply to any orthoptic procedures:

1. *Primacy.* We tend to remember (learn) better the first procedures in a series.

2. *Recency.* The latest procedures in a series also leave a more lasting effect than those in the middle. Therefore, an exercise series should be relatively short to take advantage of the elements of primacy and recency.

3. *Vividness.* Exercise of any sort should be such as will hold the attention, invoke the imagination, and not result in boredom.

4. *Frequency.* In learning, this is the most important of all. Constant repetition of small learning periods is much more productive than long infrequent sessions.

5. *Emotional congruency.* The patient must want to do the exercise. Very little can be accomplished without the eager coöperation of the patient. Children, for example, have only momentary interest in pictorial stereoscopic slides and normally none at all in geometric figures. On the other hand, they will watch motion pictures for long periods, especially the cartoon variety. I have experimented with motion pictures as fixation objects in orthoptics with promising results.

Summary

The four stimulus sources for convergence responses in heterophoria and comitant het-

erotropia have been presented and discussed. The concepts of the perimacular fusion area and the extramacular fusion area have been introduced and the rationale of the use-amplitude fraction in fusional vergence has been explained. A rational basis for orthoptic procedures has been suggested.

1324 West Main Street.

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Discussion

Electra Healy
Chicago, Illinois

It is, indeed, a pleasure to discuss Dr. Tait's paper—the informative and diagnostic concepts, which he has so clearly stated, and his presentation of the learning process.

While it is now widely appreciated that actual anatomic anomalies are met with very rarely and that the usual basis of nonparalytic faulty binocular coördination is innervational, little has been written or understood about the operation of reflex arcs or the stimuli which initiate these reactions.

An intensive study of the four stimulus sources presented and discussed by Dr. Tait, followed by a thorough review of the heterophoric and comitant heterotropic cases which have passed under your observation, will undoubtedly afford you, as it has me, a clearer understanding and more accurate diagnostic classification of the problems encountered.

In reviewing the results obtained by orthoptics for the past 10 years, I find myself in general agreement with Dr. Tait. The majority of squints due to deficiencies in tonic vergence do ultimately require surgery, but I should like to take this opportunity to stress the value of preoperative orthoptics as well as postoperative.

Visual discomfort due to deficiencies in the amplitude of fusional vergence constitutes a large percentage of cases treated orthoptically and certainly is one of the most gratifying and rewarding fields in orthoptics. Almost equally so, however, are the heterotrophic cases of accommodative convergence. These patients, in which the learned association reflex has not developed normally, may, through orthoptic procedure, be taught adequately and effectively to develop this reflex arc—the operation of which will, in some cases, obviate the use of convex lenses.

That orthoptic exercises, of whatever kind, are essentially learning procedures in which the stimulus-response mechanisms are controlled and rendered more efficient, and, as such, can be efficient only when they are applied in accordance with the principles of learning is the basic concept upon which the science of orthoptics operates.

These principles, or laws of learning, are

each an integral part of the process, and no one of them may be omitted if learning is to take place. With children, however, the mental and emotional levels, as well as somatic and neuromuscular, must await growth and development before they can be applied. The age at which all four levels are ready for response to a given stimulus is called the age of readiness.

To anyone wishing to become a serious student of orthoptics, it is necessary to have a thorough understanding of the psychology of learning and child growth, for whether the approach is physiologic or psychologic, a suitable response must be developed to visual stimuli, or the patient will be either uncomfortable or will acquire faulty visual habits.

4753 Broadway (40).

A HARD PLASTIC SPECTACLE LENS*

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INTRODUCTION

Certain of the new, transparent plastics possess properties that make them the most important new optical media since the invention of glass. Because they are made from filtered and purified liquids, they excel glass in clarity and freedom from internal haze. With a specific gravity of approximately 50 percent that of glass, they permit making lenses with half the usual weight. Possessing a co-efficient of thermal conductivity one fifth that of glass, they are highly resistant to condensation or misting. Their resilience is so many times that of glass that they are almost unbreakable.

Such substances quite evidently create the possibility of ophthalmic lenses superior in many ways to those of glass. The principal limitation to the wide use of plastic lenses in the past resulted from the fact that they were made from materials which were quite susceptible to abrasion. It is the purpose of this paper to report the development of lenses from the most abrasion-resistant of the optical plastics. These new lenses have the advantages inherent in plastics and at the same time are 40 times more resistant to abrasion than previous lenses of their type.

DISCUSSION

Two major types of plastics have been developed: The thermoplastics, which soften under heat, and the thermo-setting plastics which, once hardened under heat, cannot again be softened by it. Neither type lends itself to grinding and polishing as glass does. Their great resilience makes grinding difficult, while their high co-efficient of thermal expansion interferes with polishing. Furthermore, polishing appears to result in an abnormal condition of stretched and deformed surface molecules. These tend to right themselves by slowly returning to the original surface conformity.

Plastics do, however, lend themselves to molding and die-casting. When the proper conditions are maintained, it is possible by such forming to produce surfaces of superior ophthalmic quality.

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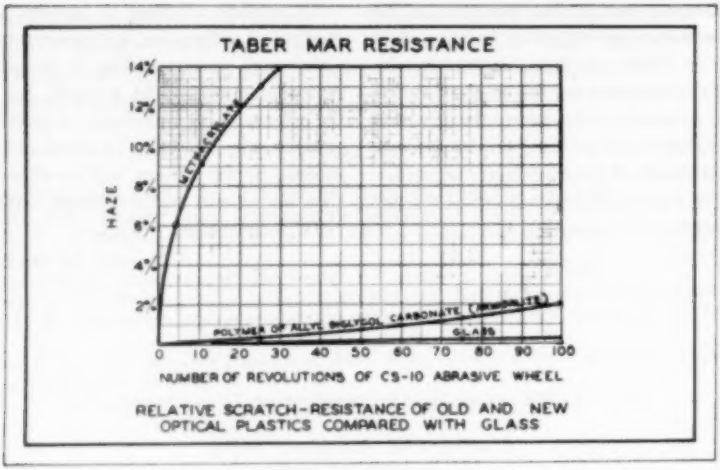

Fig. 1 (Nugent and Graham). A hardness 40 times that of methacrylate may be arrived at indirectly from the graph by a system of extrapolation which eliminates the artefact introduced by the re-scratching of already scratched areas.

Since the polystyrenes are one of the most tractable of optical plastics, they were the first to be formed into good lenses. They proved to be too soft for ophthalmic use. The next materials tried were the methacrylates of commerce: Lucite and Plexiglas. Lenses of these were introduced in America in 1937. Although they found a number of enthusi-

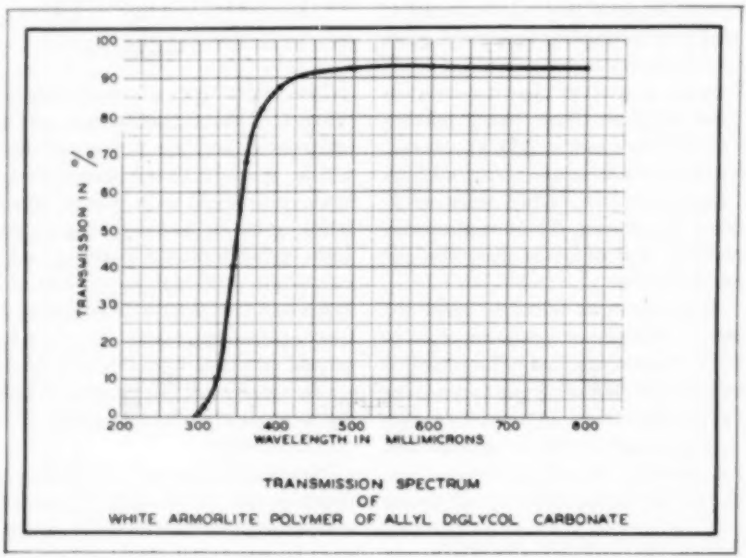

Fig. 2 (Nugent and Graham). Tranmission spectrum.

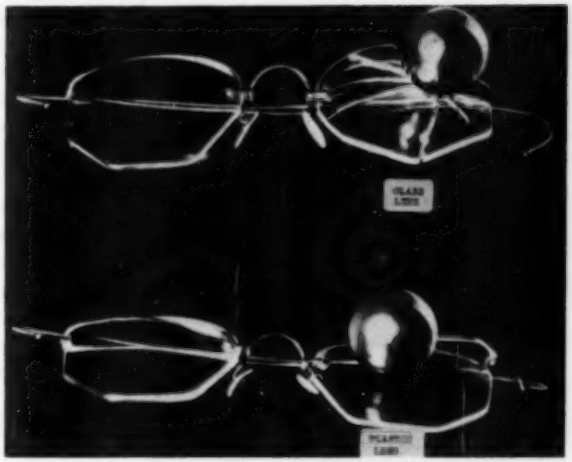

Fig 3. (Nugent and Graham). A seven-eighths-inch ball is photographed at the instant of impact on a lens of glass and one of plastic.

astic users, they were still rather soft and were no longer made here after 1939. For the next eight years plastic spectacle lenses were not available in America.

A number of major research projects were launched to find ways to produce harder lenses of optical plastics. One of them, begun in Pasadena in 1947, resulted in a process which eliminated internal flow and turbulence during forming. This permitted the use of the hardest available types of the thermoplastic methacrylates. These were free of plasticizer (softener), hence were appreciably harder and more heat-resistant than lenses previously available. Greatly improved lenses subsequently replaced this type, but these were noteworthy as the first practical plastic spectacle lenses to be developed in America.

A number of projects, including one financed by the United States Government at the California Institute of Technology,* were concerned with hardening the surface of the methacrylates. Good progress was made and a practical hardness about 10 times that of the original material was achieved. Greater hardness, while easily attained, was found to lead to fine cracking and crazing of the surfaces. Under pressure or flexing, overhardened surfaces cracked much in the manner of brittle icing.

A 10-times hardness is a significant gain. Lenses so hardened were used on a substantial scale. However, even these did not approach the abrasion resistance possessed by certain of the thermo-setting optical plastics. In the latter the chemical bonds established between the molecular chains resemble the three-dimensional network of diamond. Such a cross-linked molecular structure results in

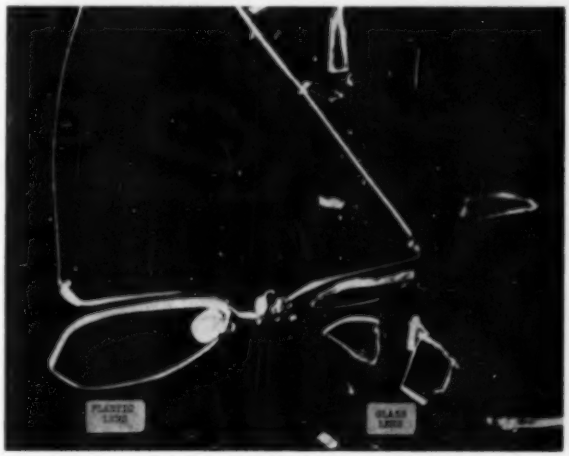

Fig. 4 (Nugent and Graham). A pair of lenses, one of glass and one of plastic, fall to the pavement from eye level.

* National Defense Research Committee Contract OEM sr-70 (1940).

Fig. 5 (Nugent and Graham). A single lens of glass weighs more than two plastic equivalents.

far greater abrasion resistance than that of the linear-linked thermoplastics such as the methacrylates.

With this cross-linked, heat-hardened type of plastic, problems of lens forming arise from the fact that the material, once solidified, cannot be softened or re-formed. Furthermore, during its one solidification, its volume diminishes as much as 14 percent. Flat sheets may readily be formed from the liquid raw material, but where the surfaces are not parallel, as in lenses, the problem of differential shrinkage is introduced. Absolute control of shrinkage is essential to accurate optics.

Ingenious efforts were made to overcome these problems. When the lenses shrank from their molds, one research group undertook to fill the resulting spaces with additional fluid raw material prior to a second curing. Another group mixed plastic granules with the liquid material so that most of the mass would have undergone shrinkage before its placement between molds. These approaches introduced their own problems of optical nonhomogeneity and easier splitting of the material. To date they have proved impractical.

It can now be reported that a process has been developed in which the differential shrinkage during curing is so controlled that accurate and perfectly homogeneous lenses can be produced from the hardest known optical plastic.*

Such lenses have as much as 40 times the abrasion resistance of their predecessors. They may be cleaned repeatedly with any common cloth or tissue without harm. It is estimated that, under average conditions, they will given excellent service until time for the prescription to be verified or changed. The earliest of these lenses have now been in constant use for more than a year and show no significant effect from repeated cleanings and daily wear.

Such lenses are superior to spectacles of glass in their resistance to all of the common chemicals. Because of their resilience and low thermal conductivity, they are at least 10

Fig. 6 (Nugent and Graham). Print is photographed through two lenses of identical power, one of glass and one of plastic, to show the excellent clarity of optical plastic.

* Armorlite, a polymer of the diallyl-phthalate, allyl diglycol carbonate, specially catalyzed.

times as resistant as glass to welding spatter and flying particles from grinding wheels. When steel pellets are shot against the material, the minimum break point is five times that of case-hardened glass. Even when their thickness is considerably reduced they still equal or surpass the best case-hardened glass goggles under the standard drop-ball test. Eye safety is secured with a fraction of the weight previously necessary. So much of

TABLE 1

COMPARISON OF CONSTANTS

	Glass	Methacrylate	Polymer of Allyl Diglycol Carbonate
Specific gravity	2.5	1.2	1.25
Refractive index (n_D)	1.52	1.49	1.5
Resistance to fogging (times glass)	1.0	5.0	4.5
Light transmission (%)	88	90–92	90–92

lightness, hardness, and safety have not heretofore been combined in lenses.

These lenses, cast in 54-mm. uncut form, are at present made in sphere powers ranging from plus 7.5D. to minus 10.0D. Cylindric powers range up to plus 4.0D. Spherocylindric lenses are produced in any combination within the above limits. Prism is available up to eight prism diopters. Green and neutral tints are produced and are noteworthy as being perfectly uniform in color density, regardless of differing thickness due to lens power. Bifocals, cataract lenses, and coated lenses are now being produced experimentally and are equally as promising as the present forms.

The virtue of a lens which eliminates half the usual weight is self-evident in cases requiring heavy corrections. On those living in cold climates or working in refrigerated areas, the annoyance from fogging is strikingly reduced. On children, athletes, sportsmen, industrial workers, and people with only one good eye, the eye-safety factor is of especial value.

Fig. 7 (Nugent and Graham). Pouring monomer into mold.

Fig. 8 (Nugent and Graham). Removing plastic lens from mold.

CONCLUSION

The lightest of all types of lenses, the clearest, and the safest to wear have now had their one serious limitation, namely, susceptibility to abrasion, reduced to negligible proportions. Light-weight ophthalmic lenses which have outstanding qualities of resist-

ance to abrasion, chemicals, fogging, and physical impact are now being produced.

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ACKNOWLEDGMENT

The making of lenses from the thermo-setting plastics requires the successful union of organic chemistry and optical physics. Among those whose personal counsel or whose work contributed significantly to this development are: Dr. Linus Pauling and Prof. Howard Lewis of the department of chemistry, California Institute of Technology; Dr. Reed Brantley and Dr. Frank Lambert of the department of chemistry, Occidental College; Dr. H. Mark of the Brooklyn Polytechnic Institute; and Dr. Ewart Williams of Pasadena. The years of work by the research staff of the Armorlite Lens Company of Pasadena must also be acknowledged.

PATHOLOGIC ASPECTS OF RETROLENTAL FIBROPLASIA*

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I personally owe a great debt of gratitude to the late Dr. Terry for having put this disease on the map; for in the past I have sinned, I hope not alone, in diagnosing it as pseudoglioma and in being satisfied with this diagnosis. It does, of course, come under the heading of pseudoglioma in that clinically it may be mistaken for a retinoblastoma, but it is of a very special type.

Reese and Payne, Krause, Owens and Owens, and a number of others have each added some new facts to this disease entity. There are, however, a number of points that still seem obscure, the main ones being the nature of the retrolental vascular tissue, the cause of the retinal detachment which in a typical case accompanies the disease, and the curious usual time of onset—namely, within the first six months after birth.

To understand retrolental fibroplasia from a pathologic point of view, it is essential I think to compare and contrast three conditions:

1. Remains of the posterior vascular sheath or hyperplasia of the primary vitreous (Reese).
2. The usual type of pseudoglioma.
3. Retrolental fibroplasia (Terry); congenital encephalo-ophthalmic dysplasia (Krause).

* From the Institute of Ophthalmology. Presented before the Royal Society of Medicine, December, 1949. From the Proc. Roy. Soc. Med., March, 1950, by permission of the honorary editors.

1. REMAINS OF THE POSTERIOR VASCULAR SHEATH OR HYPERPLASIA OF THE PRIMARY VITREOUS (Reese)

This condition has of course been known a long time and there is a huge literature to which Treacher Collins and Parsons have made notable contributions.

Pathologic anatomy. Here we find a saucer-shaped or pyramidal mass at the back of the lens. It is thickest in the center and thins out toward the periphery where it may be absent allowing a red reflex to be obtained in the living (Reese). The mass consists of connective tissue, cells, and fibers, and contains a varying number of vessels. Running forward into the apex of the pyramid is (usually) the remains of the hyaloid artery.

The posterior lens capsule may be intact or missing. In the latter case the fibrous tissue passes through the gap, the capsule at the edges being as a rule wavy and thickened. The lens itself is usually clear at first but may become opaque later. The retina here is not detached. The condition is present at birth and is most often unilateral. Pathologically therefore it is very different from the two other conditions.

2. THE USUAL TYPE OF PSEUDOGLIOMA

This arises as a metastatic uveitis or retinitis and occurs as a rule in children, aged about two years. For our purpose today I would draw special attention to the fact that

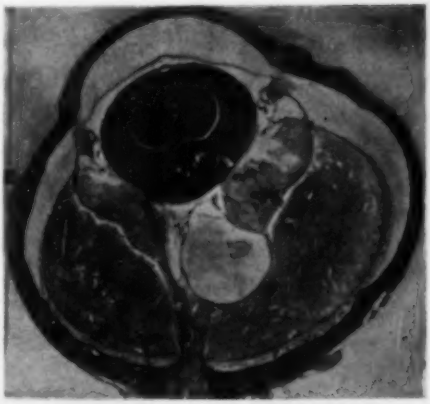

Fig. 1 (Wolff). *Pseudoglioma.* Retina completely detached and thickened right up to attachment at ora.

the signs of iridocyclitis in the anterior portion of the eye, that is the slight injection, the keratic precipitates, and perhaps a synechia or two, come at the beginning of the ocular disease.

Pathologic anatomy. Here the anterior part of the eye up to the pars plana is usually almost normal; it is in the posterior portion that the main changes are seen. The retina is totally detached and it resembles a convolvulus flower. Posteriorly it usually forms a strand running forward from the disc. I would emphasize that the detachment ends at the ora serrata.

The retina is greatly thickened, a thickening which (again I would emphasize the point) goes right up to its site of attachment. It is also much altered. The funnel formed by the detached retina is filled by a vascularized connective tissue and blood vessels can be seen to pass from the detached retina into the central strand. This central connective tissue reaches to the back of the lens and is continuous with the cyclitic membrane which is always present.

The cyclitic membrane may be in any of the four stages usually described but, as a rule, consists of a vascularized con-

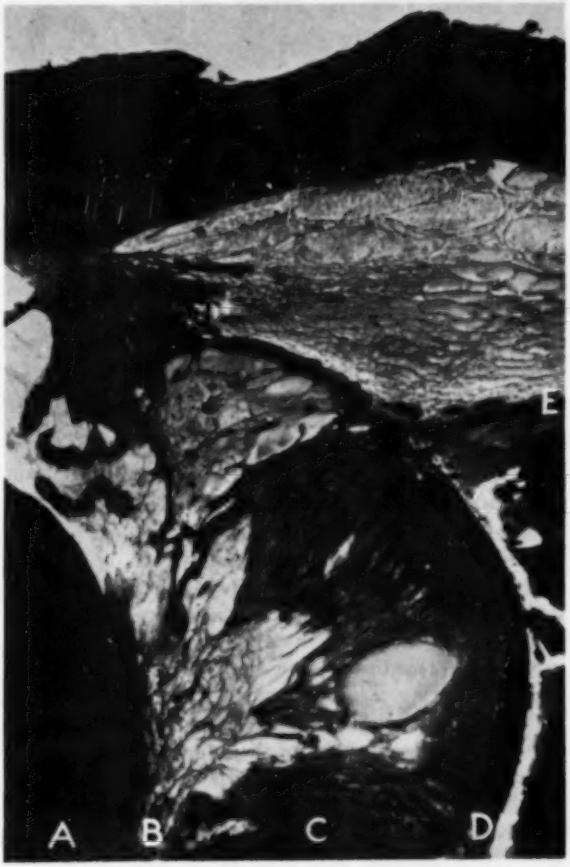

Fig. 2 (Wolff). *Pseudoglioma.* Note retina is thickened right up to ora. (A) Lens. (B) Cyclitic membrane. (C) Detached retina. (D) Retroretinal cyclitic membrane. (E) Choroid detached.

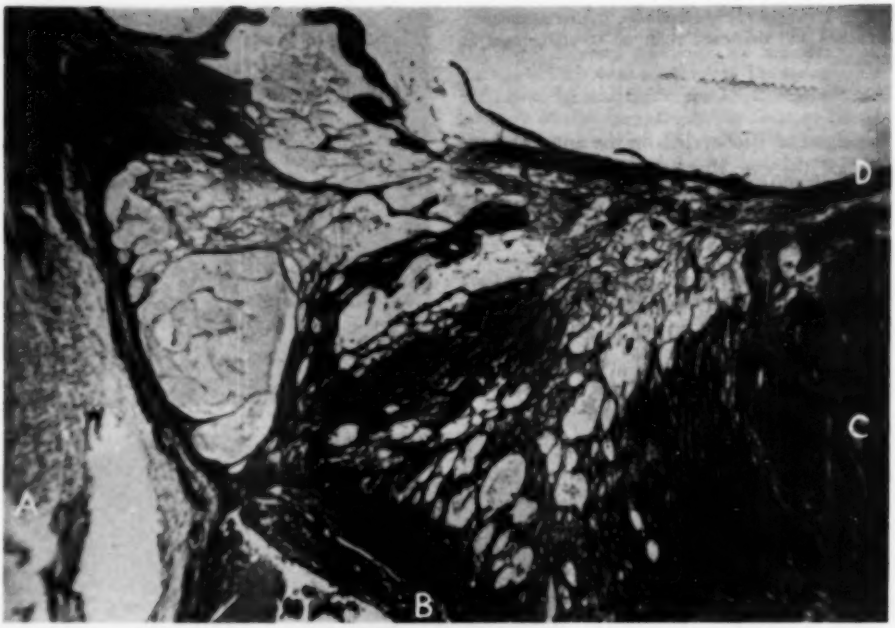

Fig. 3 (Wolff). *Pseudoglioma.* Note retina thickened right up to attachment at ora. (A) Ora serrata. (B) Retroretinal cyclitic membrane. (C) Detached retina. (D) Lens capsule and cyclitic membrane.

nective tissue into which the clear and pigmented cells of the pars plana of the ciliary body have proliferated. This cyclitic membrane is attached to the retina and vessels pass out of the latter into the cyclitic membrane.

The cyclitic membrane is situated in the anterior angle between the detached retina and the pars plana. This is of course common-place knowledge. But what is less well known is that in the posterior angle between detached retina and the pigment epithelium a vascularized pigmented mass often grows backward from the junction of the ciliary body and the choroid at the ora serrata. It may be adherent to the outer aspect of the retina or to the pigment epithelium or to both. It goes through all the stages of the cyclitic membrane in front of the retina and indeed may be called a retroretinal cyclitic membrane.

The subretinal space is filled with a coagulated mass staining red with eosin and speckled with cholesterin crystals, which may be quite free from cells but usually contains desquamated degenerating pigment epithelial cells and fatty granular cells (ghost cells of Coats).

3. Retrolental fibroplasia (Terry) Congenital encephalo-ophthalmic dysplasia (Krause)

It is of great importance to note that Owens and Owens by examining premature babies from birth found that a retinal detachment starting at the periphery preceded the retrolental membrane and the posterior synechias. They also established that all visible remains of the hyaloid system disappeared early in postnatal life.

Pathologic anatomy. Superficially a section of a typical case of retrolental fibroplasia resembles that of a pseudoglioma. There is a complete detachment of the retina with a stalk posteriorly and a folded thickened

retina anteriorly; there is the subretinal fluid staining pink with eosin and there is or *may be* a vascularized membrane behind the lens. But on closer inspection important differences are seen.

It seemed to me that the first problem to solve was to try and establish the nature of the retrolental membrane. Terry and Reese thought it had to do with the hyaloid system of vessels or the primary vitreous. But grave doubt was thrown on this hypothesis when Owens and Owens found that all visible remains of the hyaloid system disappeared early in postnatal life. In many of Krause's cases also there was no membrane at all.

Actually the membrane consists of vessels which are usually capillary and connective-tissue fibers which are exceedingly

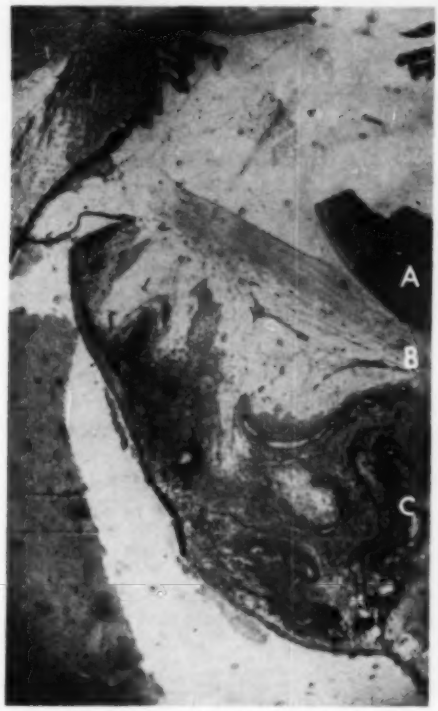

Fig. 4 (Wolff). *Retrolental fibroplasia.* (A) Lens. (B) Membrane. (C) Detached retina.

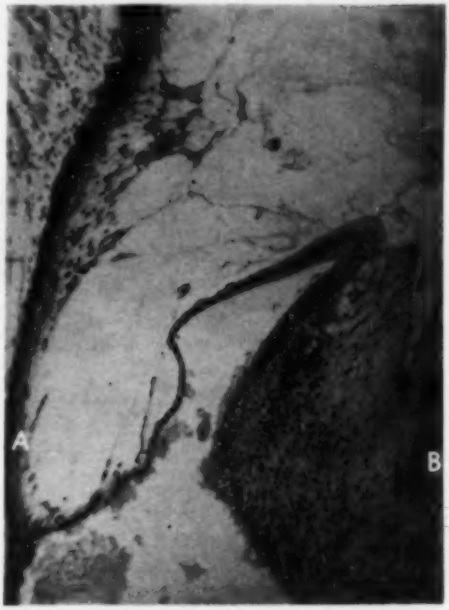

Fig. 5 (Wolff). *Retrolental fibroplasia.* Note that detached retina is attached to pars plana by ciliary epithelium. (A) Pars plana. (B) Retina.

fine, the whole looking like embryonic tissue. But there can be little doubt that it is a cyclitic membrane! In the first place a cyclitic membrane is by far the commonest cause of a pathologic vascularized tissue behind the lens and a very good reason must be produced in any given case to prove that it is not.

Here the membrane consists not only of vessels and fibers but of proliferated epithelium which can quite easily be traced to the ciliary body. Also the membrane as observed clinically appears to develop from the periphery. Only, I would suggest that in retrolental fibroplasia the cyclitic membrane is produced by a very much milder toxin than that in pseudoglioma.

This is further shown by the fact that I have found only the clear cells of the pars plana growing into the membrane and not the pigmented ones as well. A retroretinal cyclitic membrane is very rare. Now a

Fig. 6 (Wolff). *Retrolental fibroplasia.* To show detachment extending to ciliary processes. (A) Retina.

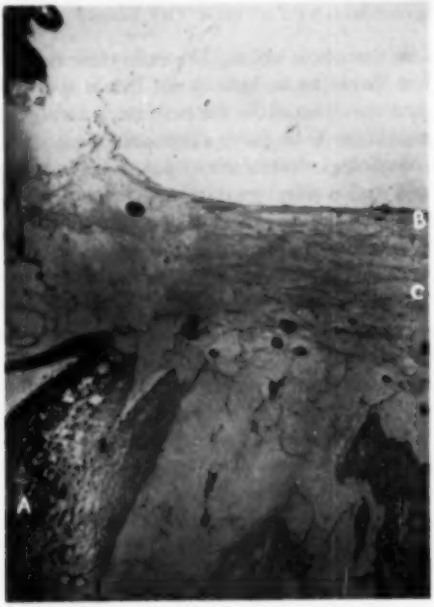

Fig. 7 (Wolff). *Retrolental fibroplasia.* (A) Retina. (B) Capsule. (C) Membrane.

cyclitic membrane signifies inflammation. Actually the signs of inflammation are exceedingly slight but that inflammation does supervene is shown also by the posterior synechias which often appear during the course of the disease.

Having established this fact, the next was to look for a cause for this mild iridocyclitis. A probable cause was obviously to hand in the presence of the retinal detachment; for we have all had cases of retinal detachment returning after months or years with a ring synechia. Fuchs showed that the reason for this was that the subretinal fluid became toxic and, if injected into the eye of an animal, could produce an iridocyclitis.

This type of iridocyclitis usually supervenes months or even years after the detachment; but it is also important to mention that it may never occur.

The next step was to look for a cause of the retinal detachment. This I think is, in a typical case, to be found in the remarkable difference between the appearance of the de-

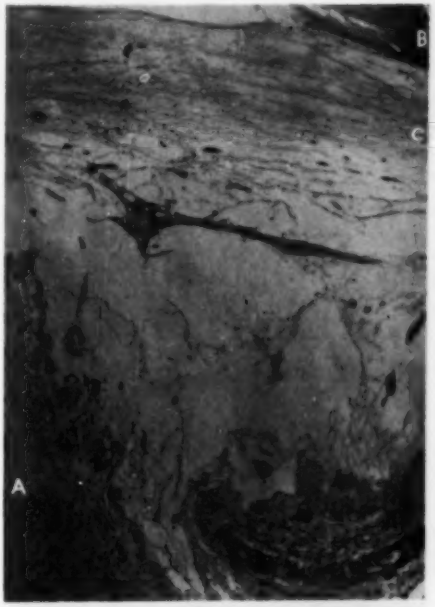

Fig. 8 (Wolff). *Retrolental fibroplasia.* Note that the retrolental membrane consists of connective tissue, vessels, and proliferated clear cells of ciliary body. (A) Detached retina. (B) Lens. (C) Membrane.

tachments in pseudoglioma and retrolental fibroplasia in their anterior portions.

In pseudoglioma the retina as mentioned before is thickened right up to its attachment at the ora serrata; in retrolental fibroplasia it usually terminates in a thin portion which looks like the clear cells of the pars plana and is attached at varying distances along the pars plana. Krause tells us that in a number of his cases the detachment went right up to the first ciliary process and this is also seen in Figure 6. Now the clear and the pigmented cells of the pars plana unite at about the third or fourth month of intrauterine life and this union is very firm. Hence, of course, retinal detachments normally end at the ora.

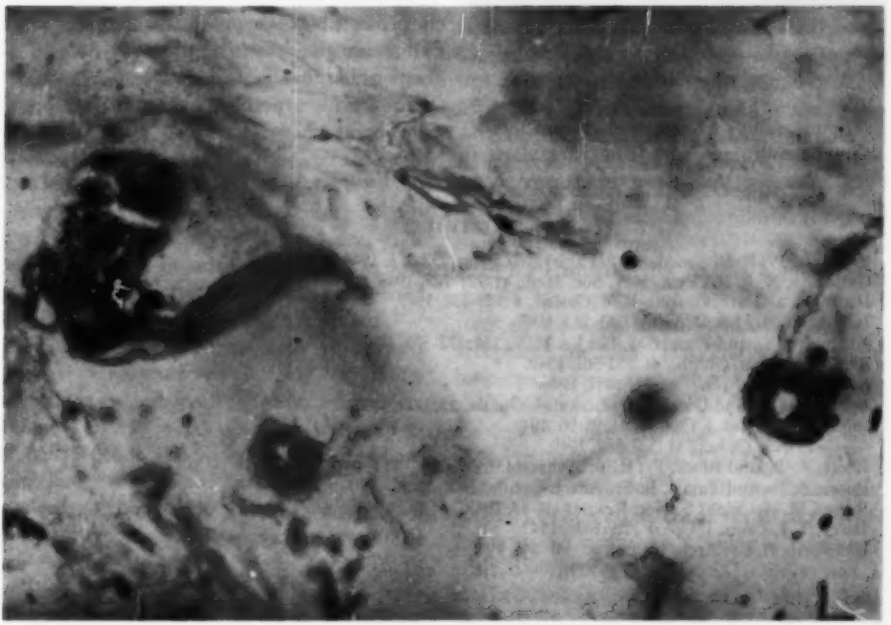

Fig. 9 (Wolff). *Retrolental fibroplasia.* Detail of retrolental membrane. Note ciliary epithelium (clear cells) and vessels.

Fig. 10 (Wolff). *Retrolental fibroplasia.* Proliferating ciliary epithelium.

The meaning of the fact then that the detachment continues on to the pars plana is most probably that there has never been proper union between the clear and pigmented cells. Later one would suggest a real detachment takes place by fluid collecting between the two layers and gradually spreading backward.

The above is an account of a typical case. But the abnormality of the retina may be present in a great many other forms. Thus the detachment may be present in its posterior part only, or there may be folds in it forming a septum and so on.

It would seem then that in a typical case the course of events is as follows:

A "noxious stimulus" reaches the embryo very early, probably in the first few months of intra-uterine life. Its effect on the eye is primarily on the retina which remains non-attached in part or as a whole. (The noxious stimulus may affect other parts of the organism especially the brain as pointed out by Krause, hence his name for the disease—encephalo-ophthalmic dysplasia). Fluid collects under the retina and a real detachment is produced which gradually becomes total. This may give rise to a mild uveitis which is responsible for the retrolental membrane and the posterior synechias when these are present.

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THE RELATIONSHIP OF HETEROPHORIA TO DEPTH PERCEPTION IN AVIATION*

With particular reference to the work of the Royal Canadian Air Force

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Part II†

IV. The effect of anoxia and fatigue upon heterophoria and depth perception

Whereas much of the experimental work dealing with heterophoria and its effect upon depth perception and flying performance is not of a sound character, the same cannot be said of that dealing with the effect of anoxia and fatigue. In the United States, and latterly in Germany and France, much of the support for the present ocular muscle balance standards has come from findings obtained in experiments on the effect of anoxia and fatigue.

The earliest work on this subject was carried out in the United States. There, in 1918, Wilmer and Berens[177] published the results of their pioneer investigations. One hundred and forty-seven men with normal eyes were studied with the Henderson rebreather simulating altitudes of 15,000 to 20,000 feet. Abduction and adduction losses were of the order of 1.3 degrees to 1.9 degrees; 50 percent showed decreased convergence, 17.6 percent showed increased convergence, 11.5 percent showed a fluctuation of convergence, and 20.6 percent showed no change in it.

Of 11 subnormal men used as controls (six were disqualified because of faulty visual acuity and five for ocular muscle imbalance) five showed a decrease in the power of convergence, two showed increase of convergence, two showed fluctuation, and two showed no change. Similar tests carried out in the low-pressure chamber gave essentially the same results. In the low-pressure chamber studies of the subnormal group, recession of the near point of convergence was great, leading to diplopia in some cases. This effect in the decompression chamber seemed to be due to anoxia and not decompression, as the administration of oxygen produced rapid recovery.

Fatigue of convergence was studied also with the Howe ergograph. The study was carried out under anoxic conditions produced by the rebreather and the decompression chamber. At 15,000 and 20,000 feet of simulated altitude, fatigue of convergence was greatly hastened. This was corrected rapidly by the administration of oxygen.

In 1919, Wilmer[178] published a paper confirming further the findings of the first investigations. He found in a group with normal muscle balance 7.37 percent had the field of binocular fixation reduced by anoxia; whereas, in an abnormal group, the field of fixation was reduced in 50 percent. He felt that anoxia had a more severe effect on those with exophoria and hyperphoria than on those with esophoria.

In the United States further confirmatory data[179] were published in 1919. The subjects of the experiment were 35 candidates acceptable for pilot duty. The ocular-muscle balance of these was studied under anoxic conditions produced by the rebreather and the low-pressure chamber at simulated altitudes of 5,000, 10,000, 15,000, and 20,000 feet for five minutes. In all the subnormal subjects examined, particularly in those with convergence insufficiency, alone or combined with divergence (exophoria), there was a marked loss in the power of adduction, and diplopia often occurred between 10,000 and 15,000 feet. Men with over one degree of hyperphoria, particularly when it was com-

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bined with exophoria, showed a rapid reduction in muscle strength, which often resulted in diplopia. The work thus demonstrated that exophoria and hyperphoria are more objectionable than esophoria.

In this investigation, stereoscopic vision also was studied. Of the 19 normal subjects examined, three (15.7 percent) showed loss of stereopsis at 20,000 feet, and of seven men ocularly disqualified for pilot duty, stereopsis was lost in only one case. In no case was a change in stereopsis noted at simulated altitudes less than 20,000 feet. In another series, seven "normals" and nine "subnormals" were tested in the low-pressure chamber at simulated altitudes of 10,000, 15,000, and 20,000 feet. All the normals remained unchanged, and only one subnormal showed confusion of stereopsis. This latter was noted at 15,000 feet, and rapidly recovered on the administration of oxygen.

Weldon[180] in 1924, when discussing a paper by Sauer, made the following dogmatic statement: "Diplopia is caused by lowered O_2-tension only in those cases in which there is latent squint—heterophoria. This double vision, and when it comes on it is a frank and uncontrolled double vision, may develop at any altitude over 10,000 feet. It is particularly liable to occur in one having hyperphoria. . . . The amount of hyperphoria need not be large, because at sea-level conditions these cases have good binocular fixation." It is a significant fact that ocular-muscle balance is affected by anoxia in many cases, yet stereopsis, which is the really important matter, is affected only in a few.

This early work was done quite carefully, and would seem dependable. Wilmer[181] in 1923, reviewed the subject up to that time, and Berens,[88] in 1931, wrote a very complete paper reviewing all aspects of the visual standards. In this article, Berens emphasized the importance of stable ocular-muscle balance because of the deleterious effects produced by anoxia. He could not agree with a statement of Howard's[29] that, "the effect of low oxygen tension on the depth perceiving sense is of little importance in aviation because the critical time during the flight is in landing, where there is no lack of oxygen." Berens felt that pilots may be forced to make crash landings after flying for a time at high altitude. He stated that he himself knew of several crashes that took place in this way. Beyne,[182] in 1928, and Simpson,[183] in 1933, further confirmed the data published up to that time, stating that heterophoria tends to become heterotropia under conditions of anoxia.

In Germany, Velhagen,[150] in 1937, carried out a detailed investigation of the effect of altitude. He examined 16 young men in the decompression chamber at altitudes up to 18,000 feet. After exposure to this altitude for three minutes, he found that there was a marked increase of convergence in those with primary esophoria for distance, whereas, there was an increased convergence insufficiency in those with primary exophoria for near. Diplopia did not occur at any time at these altitudes. In all cases, the ocular muscle balance returned to normal on the administration of oxygen or on return to normal atmospheric pressure.

McFarland,[184] in 1937, published his findings in a study of 10 individuals at 20,000 feet during the International High Altitude Expedition to Chile. He found no significant alteration in the heterophoria for a distance of six meters. But for 40 centimeters distance there was an increased heterophoria, usually of a convergence insufficiency type. In experiments in a low-pressure chamber, McFarland[185] obtained essentially the same findings. In his study, the alterations in heterophoria were reliable statistically only at altitudes of 14,000 feet and above. These studies were confirmed by Furuya,[186] in 1937, and by Pol,[187] in 1938.

McFarland, Knehr, and Berens,[188] in 1937, studied the effect of anoxia upon the coördinated ocular movements of individuals with essentially normal ocular muscle balance. They found that it took longer to read a line at 18,000 feet, and that the eyes did

not coördinate well. There was a general tendency toward diminished precision of ocular fixation. In a second similar study,[189] by the same authors on a group with known ocular anomalies, the defects were greatly accentuated. Ocular imbalances were increased, and in some cases there was a tendency to suppression.

Latterly, 1947, Duguet[190] has studied the effect of anoxia upon stereoscopic vision. He came to the conclusion that this function is particularly resistant to anoxia. In this he is in agreement with the findings of Heinke,[191] and with those of the United States Air Service[170] already mentioned.

Although there have been relatively few studies on the influence of anoxia on heterophoria and depth perception, all of them are essentially in agreement. There is a tendency toward increase of lateral displacement of the eyes with weakening of the convergence at high altitudes. This effect would seem to be due to anoxia and not to decompression. The literature of this field up to 1941 has been reviewed admirably by McFarland, Evans, and Halperin.[192]

The literature on the effect of fatigue upon heterophoria is scanty, and for the most part of a rather nebulous character. Anderson[193] was one of the first to emphasize the importance of physical and emotional strain—what now has come to be called "flying stress." In 1919, he stated that this matter should be studied further. He felt that the main factors causing flying stress were anoxia and emotional strain.

Berens and his co-workers,[194,195] in 1926, studied this question more fully, with particular reference to convergence. In a later paper in 1940, Berens[196] again emphasized the deleterious effects of fatigue and anoxia.

Adams,[197] in 1928, reported a follow-up study of a group of 100 naval pilots. Of this group, 32 percent had flown since 1924, and the remainder since 1925. In 27 percent the exophoria had remained stationary. It had increased two prism diopters in 49 percent, and seven prism diopters in 12 percent. It had reached or exceeded the limits of the flying standards in 13 percent. Waivers were required in seven percent. However, Adams noted that esophoria seemed to give little trouble.

Davis,[198] in 1933, noted that even among nonflyers latent imbalances may become more and more difficult to tolerate with increasing age. It is likely that the failure of accommodation may play a part in many cases.

The deleterious effect of anoxia on accommodation has been pointed out by many workers in this field.[168, 177–179, 181, 182] Ikemune,[199] in 1940, pointed out that its range is moderately reduced even at an atmospheric pressure of 450 mm. Hg. Scobee,[200] in 1944, reported on the deleterious effect of exhaustion and moderate anoxia combined. Cusick[201] has written on this subject also. Borges Diaz,[202] on examining Brazilian commercial pilots, has reported the finding of increased heterophoria resulting from fatigue.

As already mentioned, there is no doubt of the adverse effects of anoxia and of fatigue. However, in the interpretation of the importance of these factors certain facts should be noted. Most of the workers in this field, particularly the earlier ones, feel that this is reason enough to enforce certain limitations of ocular muscle balance. The development of new flying techniques, particularly during World War II, has rendered such limitations largely unnecessary.

In the Royal Canadian Air Force—the only service of which I can speak with authority—it was rare indeed for a pilot to fly above 10,000 feet without oxygen. It is understood that this same condition prevailed in other air forces. The extreme sensitivity of scotopic vision to anoxia, which has been reported by many workers,[202, 203] made this imperative.

In the Royal Canadian Air Force, on night-flying operations, the aircrew wore their oxygen masks and started the oxygen flow at the time of take-off. During day-operations, if the pilot planned on going

higher than 10,000 feet, he did the same thing. If he planned on staying lower than 10,000 feet, he wore his mask, but usually did not turn on his oxygen unless he changed his plans and climbed higher. It was usual for the pilot to set the oxygen flow for the amount specified for 5,000 feet above the height he was flying at, so that he would be assured of a safety factor. The development of pressurized fuselages in the latter part of the war simplified the problem. Thus, the problem has become essentially academic.

I was in an excellent position during the last war to know of any cases of disturbed ocular muscle balance from this cause. Only one case came to my notice—that of Sergeant P., a Spitfire pilot, who was returned to Canada from England because of the occurrence of diplopia on coming down from high altitude in preparation to land. On investigation in the low-pressure chamber, it was found that he developed esotropia on coming down from altitude, and not on ascent. It was not relieved by the administration of oxygen. There was severe pain with the development of the esotropia. This pain was much like a sinus pain. It was felt likely that the esotropia was related in some obscure way with aerosinusitis. At ground level, his ocular muscle balance was well within acceptable standards. He had an esophoria of three prism diopters with good fusion.

The absence of cases of diplopia occurring on ascent to, or descent from, altitude is confirmed by the experience of Elliot, ophthalmologist to the Royal Canadian Air Force Overseas between April, 1943, and August, 1945. All patients with ocular disturbances occurring in the Royal Canadian Air Force Overseas were routed through his hands. He states[204] that he "does not know of a single case of ocular muscle defect developed as a result of anoxia." This is confirmed from the combatant point of view by W/C B. D. Russel[205] who was in command of a tactical fighter air wing, and saw service in Europe from the Battle of Britain onward to the conclusion of the war.

The deleterious effect of fatigue, not only upon heterophoria, but also upon the general psychologic and physical status, has been well recognized for several years by aviation experts. Limitations have been placed upon the amount of flying duty permitted in a given time by civilian and armed service aviation authorities in all countries. There has been a definite tendency to reduce the amount of flying time per month as the performance of aircraft has improved.

V. Methods of examining ocular muscle balance used by the Royal Canadian Air Force

In Section II the methods used by the Royal Canadian Air Force to examine the ocular muscle balance have been mentioned. It was indicated that the method of assessing this function varies greatly from country to country. That used by the Royal Canadian Air Force was developed and used for many years previously by the Royal Air Force. At this point this method should be examined, as the various studies carried out by the Royal Canadian Air Force were centered about it. Also, before one can assess the importance of stable binocular vision in flying performance one must have a reliable means of measuring it. Thus, considerable work was carried out by the Royal Canadian Air Force to test the significance and reliability of the various tests used for binocular vision and coördination.

The tests were selected originally because of their simplicity and generally accepted accuracy. They measure the amount of deviation of the visual axes when the eyes are dissociated, and give knowledge of the status of the binocular fusion. One group of tests is subjective, and the other objective.

Subjective heterophoria is measured by means of a red Maddox rod always placed before the right eye in a trial frame. Dolman,[206] as a result of his studies, stated that the Maddox rod should be placed before the nondominant eye. As has been pointed out by Scobee and Green,[207] when his data are reanalyzed there is no basis for this claim.

The findings of these latter authors in their study uphold the view that it matters not before which eye the Maddox rod is placed. The average with the rod before the dominant eye was 1.50 prism diopters of esophoria, and that with it before the nondominant eye was 1.62 prism diopters of exophoria.

Following the placing of the Maddox rod, the patient is asked to look at a pinpoint source of light 20 feet away. This test always is carried out in total darkness or subdued light. In this regard it should be noted that the work of Cridland[208] and of Scobee[209] indicates that the amount of light in the examining room does not alter significantly the reliability of the Maddox-rod test. The amount of deviation is measured in prism diopters by placing prisms appropriately before the left eye. The screen-Maddox-rod test is rarely used.

Scobee,[210] and Scobee and Green,[207] while preferring the Maddox rod combined with a screen because of its greater accuracy, feel that the simple Maddox-rod test, if carefully carried out, has quite sufficient accuracy for general use when large numbers are being examined.

During the war, most oculists in the Royal Canadian Air Force also carried out a Maddox-rod test using a minute source of light held at 15 inches. This was done for their personal information, but was not used for classification of candidates.

The deviations of the visual axes are tested objectively for near by means of the cover test. This test is carried out in the following way:

The patient is asked to look at the pointed end of a pencil or similar object placed directly before the eyes about 18 inches away and level with the bridge of the nose. One of the candidate's eyes is covered with a small card. The pencil is moved laterally two or three times to dissociate the eyes further, and then is brought to rest before the eyes and on a level with the bridge of the nose. The covered eye is then uncovered. The amount of deviation is noted roughly as the uncovered eye recovers fixation, and the type of return is noted because of its relation to the desire for fusion; good fusion being denoted by a rapid and smart return, poor fusion being indicated by slow or jerky return.

Should there be no return, the cover, instead of being just removed, is transferred to the other eye, thus forcing fixation with the first eye. If a recovery movement is now noted, whereas it was not noted before, it signifies that the eye has been suppressing. The amount of recovery movement is roughly estimated and recorded by the terms, slight (up to about five degrees), moderate (about five degrees to 10 degrees), and wide (over 10 degrees).

Thus, the cover test, as carried out, gives some information regarding the dissociated position of the eyes, and the status of binocular fusion. It is a test for both these functions at near. It is an objective test. The status of binocular fusion is tested also by means of the Bishop Harman diaphragm test,[49] which already has been described in Section II. This is a subjective test, and measures what Harman referred to as the "desire for fusion."

Convergence is tested both objectively, and subjectively by means of the Livingston binocular gauge.[135] The near point of accommodation also is determined with this instrument. The distance, expressed in centimeters, is measured from the anterior corneal surface.

Visual acuity is measured with the Project-O-Chart of the American Optical Company, with the patient in dim light or almost total darkness.

As has been pointed out, the first prerequisite in carrying out any investigation of human endeavor is to determine the reliability of the test procedures. This is all the more important when the procedures are of a highly subjective nature. It is amazing how infrequently investigations of the reliability of these tests, or others similar to them, have been reported in the ophthalmic literature.

In 1943, Minnes, Crawford, and Shagass presented a report[211] of such a study dealing

with the tests used by the Royal Canadian Air Force. The first two authors, being ophthalmologists, carried out independently on the same day the standard test procedures on 100 airmen. They studied the following tests: the Maddox rod (at 20 feet and at 15 inches), the Bishop Harman diaphragm test, objective convergence, subjective convergence, accommodation, and the cover test in the manner already outlined (the response, or deviation, was estimated as slight, moderate, or wide, and the recovery as rapid, borderline—such as slow, jerky, or return after a pause—or no recovery). They found that the following margins of error were required to obtain 90 percent agreement between the examinations of the two ophthalmologists:

Maddox rod at 20 feet	2 prism diopters
Maddox rod at 15 inches	5 prism diopters
Bishop Harman	2 ocular poise units
Objective convergence	1 centimeter
Subjective convergence	4 centimeters
Accommodation	2 centimeters
Cover-test response	1 descriptive step
Cover-test recovery	1 descriptive step

The findings relative to the Maddox-rod test agree very well with those of Scobee and Green published in 1947.[207]

It is the custom in the Royal Canadian Air Force to consider the results of all these tests together to obtain an impression of the status of the ocular muscle balance. The assessment of the status by this method is felt to be particularly important in cases just on the borderline of the accepted standards. Since it is the custom to disregard slight deviations over the border of one test should the results of the other tests be well within standard, it then becomes important to have some actual information of the interrelationships of these various tests. It is not good enough to work only on the basis of impressions, factual information is essential.

To do just this, and to obtain detailed information regarding the flying performance of candidates with variations in their ocular muscle balance, a very detailed and comprehensive study was set up at No. 5 Initial Training School, Belleville, Ontario, early in 1942. Chronologically this was not the first study carried out by the Royal Canadian Air Force on the relationship of ocular muscle balance to flying performance. But some statistical studies, based on the findings which give information regarding the interrelationship of the various visual tests, should be considered here.

In this latter part of the study which was reported by Minnes and Shagass in 1944,[212] each candidate was examined by the methods already outlined. The findings then were coded on a master code sheet and transferred to Hollerith cards for statistical analysis.

The Maddox-rod findings at 20 feet were coded in the following subdivisions: orthophoria; esophoria, 0 to 3 prism diopters; esophoria, 3 to 4.5 prism diopters; esophoria, 4.5 to 6 diopters; esophoria, 6 to 8 prism diopters; esophoria, 8 prism diopters plus; and exophoria, 0 to 1.5 prism diopters; exophoria, 1.5 to 3.5 prism diopters; exophoria, 3.5 to 6 prism diopters; exophoria, 6 prism diopters plus.

These divisions were dictated largely by the visual standards of acceptance in the Royal Canadian Air Force for heterophoria. Also, the borders of each division lie pretty well at the limits of experimental error of the test, as has been pointed out.

The Maddox-rod readings at 15 inches, though not required by the examination for acceptance, were determined, and were coded in the following subdivisions: orthophoria; esophoria, 0 to 3 prism diopters; esophoria, 3 to 6 prism diopters; esophoria, 6 to 9 prism diopters; and esophoria, 9 prism diopters plus; and exophoria, 0 to 3 prism diopters; exophoria, 3 to 6 prism diopters; exophoria, 6 to 9 prism diopters; and exophoria, 9 prism diopters plus.

The cover test deviations or responses were coded under: slight, moderate, or wide convergent deviation; no deviation; and slight, moderate, or wide divergent deviation.

The type of recovery from the deviated

position produced by the cover test was coded under: no deviation, rapid recovery, poor recovery, and no recovery (that is, suppression or neglect).

The findings with the Bishop Harman diaphragm test were coded with regard to whether exophoria or esophoria occurred at the point of dissociation, and the point (0 to 3, 3 to 6, or 6 plus units on the ocular poise scale) at which dissociation took place. Also the occurrence of suppression or neglect was coded.

Objective convergence as measured in centimeters from the anterior corneal surface with the binocular gauge was coded in the following divisions: up to 8 cm., 10 to 12 cm., and 12 plus cm.

Subjective convergence was measured with the same instrument, and the findings coded under the following subdivisions: up to 10 cm., 10 to 13 cm., 13 to 16 cm., and 16 plus cm.

TABLE 3

INTER-RELATIONSHIP OF OCULAR MUSCLE BALANCE TESTS IN A GROUP OF 2,453 CONSECUTIVE CASES

1st Variable	2nd Variable	Contingency Coefficient
Objective Convergence vs.	Accommodation	0.47
	Maddox rod at 15 inches	not significant
	Maddox rod at 15 inches (exophoria only)	0.14
	Bishop Harman	0.27
	Bishop Harman (esophoria only)	not significant
	Bishop Harman (exophoria only)	0.41
	Bishop Harman neglect (comparison with normals)	0.15
	Cover-test response	0.22
	Cover-test response (divergence only)	0.20
	Cover-test recovery type	0.30
	Maddox rod at 20 feet	0.14
	Subjective convergence	0.47
Maddox rod at 20 feet	Maddox rod at 15 inches	0.60
	Bishop Harman	0.40
	Cover-test response	0.55
	Cover-test recovery type	0.40
Maddox rod at 15 inches	Bishop Harman	0.48
	Cover-test response	0.61
	Cover-test recovery type	0.51
Bishop Harman	Cover-test response	0.46
	Cover-test recovery type	0.34
C. T. response	Cover-test recovery type	0.42
Maddox rod (hyperphoria) at 20 feet	Maddox rod (hyperphoria) at 15 inches	0.83
	Bishop Harman	0.19
	Cover-test response	0.17
	Cover-test recovery type	0.18
Maddox rod (hyperphoria) at 15 inches	Bishop Harman	not significant
	Cover-test response	0.24
	Cover-test recovery type	0.20

Accommodation was measured with the same instrument in centimeters from the anterior corneal surface, and coded under: up to 10 cm., 10 to 13 cm., 13 to 16 cm., and 16 plus cm. In all, some 2,453 candidates, taken as they came, were studied and coded in this way.

The findings then were statistically handled to assess the relationship between the various tests in all combinations. The results have been summarized in Table 3. All the statistically significant relationships

which were found are expressed in the table in the form of coefficients of contingency. (A contingency coefficient approaches a value of 1.00 as the strength of the relationship increases.)

From this study it became obvious, as was known already, that convergence is augmented by accommodation, and that poor convergence tends to be associated with poor fusion (as demonstrated by the Bishop Harman diaphragm test and the cover-test recovery). The evidence thus confirms the belief that convergence is influenced both by accommodational and fusional impulses.

If it be assumed that divergent deviations at near represent either a hypertonicity of the lateral rectus muscles or hypotonicity of the medial rectus muscles, then the data of this study showed that muscle tonus affects convergence. Lateral deviations at distance were related to lateral deviations at near, even though the former tended to be exophoric while the latter tended to be esophoric. The data indicated that on the average the Maddox-rod reading at distance became four prism diopters more exophoric at near.

The findings with tests for lateral deviation at near (Maddox rod, cover-test response, Bishop Harman) were significantly related, but not sufficiently for accurate individual prediction. For gross prediction purposes, the cover-test response was related adequately to the Maddox-rod test.

Lateral deviations, both at distance and near, were related to fusion as measured by the Bishop Harman and the cover-test recovery. Poor fusion tended to be associated with wide lateral deviations. The cover-test recovery and the Bishop Harman findings were related, but not sufficiently to indicate that they measured entirely the same function. The hyperphoria findings for distance and for near were practically comparable. Hyperphoria greater than one prism diopter tended to be associated with poor fusion.

The findings of this study also were utilized by Minnes and Shagass[213] to obtain some information regarding the frequency of the various types of ocular muscle imbalance. The results of this study, concerning the same 2,453 aircrew, were presented in 1943. It is to be remembered that the group studied already had been selected at recruiting center level for aircrew, and included prospective candidates for all aircrew positions.

In practice, this meant that only those who had an obvious strabismus had been removed from the general population group. Indeed, it was a policy of the Royal Canadian Air Force that strabismus, when the visual acuity and general appearance were good, was not a bar to any aircrew position except that of pilot.

The findings of this study are important, not only in the estimation of the availability of aircrew material, but they also have great academic interest. A search of the literature discloses very little data concerning what may be considered the normal limits of muscle balance. The substance of the findings is recorded in Tables 4 to 12.

Taking the normal deviation of the Maddox rod as exophoria, 3.5 prism diopters, and esophoria, 4.5 prism diopters, borderline findings as exophoria, 3.5 to 6 prism diopters; esophoria, 3.5 to 6 prism diopters; and unfit as esophoria or exophoria of more than 6 prism diopters (see table 2), Table 4 reveals that 2,251, or 92.76 percent, of the cases came within normal limits, that 69, or 2.84 percent, presented borderline findings, while 107, or 4.41 percent, were unfit for pilot. Accepting White's[214] figures of 1.0 to 2.0 prism diopters of exophoria and esophoria as normal for a civilian population, it appears in this series of cases that 522, or 25.75 percent of the cases, fell outside the limits of an exophoria of 1.5 prism diopters and an esophoria of 3.0 prism diopters.

Table 5 shows that 326, or 13.53 percent of the cases, were orthophoric, while 1,265, or 52.52 percent, had an exophoria of one prism diopter to six prism diopters. This signifies that 1,591, or 66.05 percent of the cases, came within normal limits. The re-

TABLE 4

MADDOX ROD—LATERAL AT 20 FEET

M. R. 20 Ft.	Ortho-phoria	Eso. <3	Eso. 3 <4.5	Eso. 4.5 <6	Eso. 6 <8	Eso. 8+	Exo. <1.5	Exo. 1.5 <3.5	Exo. 3.5 <6	Exo. 6+	Totals
No. Cases	668	1,030	245	50	66	28	207	101	19	13	2,027
% Cases	27.52	42.44	10.10	2.06	2.72	1.15	8.54	4.16	0.78	0.54	100%

TABLE 5

MADDOX ROD—LATERAL AT 15 INCHES

M. R. 15"	Ortho-phoria	Eso. 0 <3	Eso. 3 <6	Eso. 6 <9	Eso. 9+	Exo. 0 <3	Exo. 3 <6	Exo. 6 <9	Exo. 9+	Totals
No. Cases	326	204	125	31	15	712	553	268	175	2,409
% Cases	13.53	8.47	5.19	1.28	0.62	29.56	22.96	11.12	7.25	100%

maining 818 cases, or 33.95 percent, fell outside the accepted normal standards.

Tables 6 and 7 show that hyperphoria greater than two prism diopters is slightly more frequent for near than for distance, constituting 15, or 0.62 percent, of the cases.

In Table 8 it is seen that 2,110, or 86.94 percent of the cases, came within normal limits on the ocular poise scale. That is, they presented an exophoria or esophoria reading of 0 to 3. Only one case exhibited hyperphoria. Two hundred and fifty-three, or 10.43 percent of the cases, came in the borderline group. Of these, 229, or 9.44 percent, came within the three to six reading on the ocular poise scale, while the remaining 14 cases, or 0.99 percent, showed exophoria or esophoria readings which were greater than six.

If it be assumed that the cases in this latter group did not exceed the maximum score of nine on the ocular poise scale, which would thus render them unfit for pilot, 64, or 2.64 percent of the cases, showed monocular or alternating neglect which would make them possibly unfit for pilot. However, it is not known what number of the neglect cases showed a reading on the ocular poise scale of

TABLE 6

MADDOX ROD—HYPERPHORIA AT 20 FEET

Hyper. at 20 ft.	0<1	1<2	2+	Totals
No. Cases	2,368	31	10	2,409
% Cases	98.30	1.29	0.41	100%

TABLE 7

MADDOX ROD—HYPERPHORIA AT 15 INCHES

Hyper. at 15 Ins.	0<1	1<2	2+	Totals
No. Cases	2,327	67	15	2,409
% Cases	96.60	2.78	0.62	100%

TABLE 8

BISHOP HARMAN DIAPHRAGM TEST

B. H.	Eso. 0 <3	Exo. 3 <6	Eso. 6+	Eso. 0 <3	Exo. 3 <6	Exo. 6+	Neglect Mon. Rt.	Neglect Mon. Lt.	Neglect Alt.	Hyper-phoria	Totals
No. Cases	300	39	9	1,809	190	15	8	31	25	1	2,427
% Cases	12.36	1.61	0.37	74.54	7.83	0.62	0.33	1.28	1.03	0.04	100%

TABLE 9

OBJECTIVE CONVERGENCE

Obj. Conv.	Less than 8 cms.	8<10 cms.	10<12 cms.	12+cms.	Totals
No. Cases	2,207	180	38	24	2,449
% Cases	90.12	7.35	1.55	.98	100%

TABLE 10

SUBJECTIVE CONVERGENCE

Subj. Conv.	Less than 10 cms.	10<13 cms.	13<16 cms.	16+cms.	Totals
No. Cases	597	1,170	525	133	2,425
% Cases	24.62	48.25	21.65	5.48	100%

TABLE 11

ACCOMMODATION

Acc.	<10 cms.	10<13 cms.	13<16 cms.	16+cms.	Totals
No. Cases	1,751	621	45	6	2,425
% Cases	72.21	25.61	1.86	0.33	100%

TABLE 12

COVER TEST

Cover Test Response

Response	No Dev.	Sl. Conv.	Mod. Con.	Lg. Conv.	Sl. Div.	Mod. Div.	Lg. Div.	Totals
No. Cases	1,303	90	41	1	873	122	44	2,417
% Cases	53.25	3.68	0.57	0.04	35.68	4.99	1.80	100%

Cover Test Recovery

Recovery	No. Dev.	Rapid R.	Slow R.	Jerky R.	After Pause	No Rec.	Totals
No. Cases	1,303	1,067	37	6	15	19	2,447
% Cases	53.25	43.60	1.5	0.25	0.61	0.78	100%

Response and Type

Response & Type	No Dev.	Sl. Con. R. R.	Mod. or Lg. Con. R. R.	Sl. Con. Poor R.	M. or L. Conv. Poor R.	Sl. Div. R. R.	M. or L. Div. R. R.	Sl. Div. Poor R.	M. or L. Div. Poor R.	Totals
No. Cases	1,303	87	12	3	3	849	119	24	47	2,447
% Cases	53.25	3.56	0.49	0.12	0.12	34.70	4.86	0.98	1.92	100%

N.B. Poor R. (recovery) = Slow, jerky, after a pause; No recovery. Sl. = Slight; Mod. or M. = Moderate. L. = Large. Div. = Divergent. Con. = Convergent.

six or more. Therefore, the actual number of rejects is not known by this test alone, but it can be safely assumed that it would be somewhat less than 64, or 2.64 percent of the cases.

Table 9 is self-explanatory. It would appear that few, if any, cases were rejected because of an objective convergence which exceeded the maximum borderline finding of 15 cm. Taking 8.0 cm. as the hitherto accepted maximum near point of convergence, when measured from the anterior surface of the cornea, 242, or 9.88 percent of the cases, were outside the normal standards.

Subjective convergence (table 10) findings were so variable and were dependent upon so many factors other than convergence power alone that little significance is attached to these findings except when the reading is 18 cm. or over. The unreliability of this subjective convergence test was amply proved by McCulloch in a very careful study.[215] From Table 10 it is seen that less than 133, or 5.48 percent of the cases, came in this category.

Accommodation varies according to the age of the individual. Fuchs[216] among others, in his textbook of ophthalmology presents tables giving the near point of accommodation at different ages. The average age group of the present series of cases is 22 years for which the near point of accommodation should be better than 12 cm. From Table 11 it is observed that 51, or 2.19 percent of the cases, had a near point of accommodation greater than 13 cm.

In the cover test two observations were made: (a) the magnitude of the deviation encountered, "slight" and "moderate" denoting a normal response and "wide" a borderline response; and (b) the rate and type of recovery, "rapid" signifying a normal finding; "slow," "jerky," or "recovery after a pause" a borderline finding; while "no recovery" indicated a poor response and was cause for rejection. Table 12 reveals that 45, or 1.84 percent, showed a borderline response, and 19, or 0.78 percent, had a poor recovery so as to disqualify them from piloting duties.

It will be noted that the totals of each examination given in the last column of each table never equal 2,453—the total number of candidates examined. The reason for this is that all data were not collected on all candidates owing to unforeseen occurrences in each candidate's progress through the system, such as illness, and so on.

The findings of this study may be summarized by stating that the standards used by the Royal Canadian Air Force were so lenient that remarkably few candidates fell outside the standards for pilot duty. To be precise, the rejection rate for lateral and vertical deviations with the Maddox rod at 20 feet was 4.82 percent; with the Bishop Harman diaphragm test the rate was 2.64 percent; and with the cover test the rate was 0.78 percent.

The next problem in the use of these tests for the selection of pilot candidates is to determine how variations in the tests affect the acuity of stereopsis. Elliot,[40] in 1942, carried out the earliest work in this regard. He selected 222 aircrew candidates at random from the larger study of 2,453 individuals being carried out at No. 5 Initial Training School, already mentioned. The acuity of stereopsis in this group was estimated by means of the Livingston rotating depth-perception apparatus and rotating stereograms.[217] These latter estimations were carried out by Miss G. Irvine, an orthoptist.

In reviewing these data, Elliot could find no relationship between the degree of heterophoria and the acuity of stereopsis as measured by these instruments. His findings are summarized in Figure 1. They uphold those of Junker,[161] Counsell,[170] and Travers.[218]

All these findings are not surprising, since at a later date, at the Orthoptic Clinic at No. 1 Manning Depot, all attempts to formulate a method of obtaining repeatable results with the rotating stereograms and rotating depth-perception apparatus failed.[218, 220]

In 1944, Kirschberg[219] presented a most

detailed study of the interrelationship of the ocular muscle balance tests, and their relationship to stereopsis and flying performance. This later was published.[220] His findings regarding the relationship of these functions either way, and the degree of heterophoria. Nor did he find any relationship between these and the acuity of binocular stereopsis, as determined with his modification of Verhoeff's instrument.

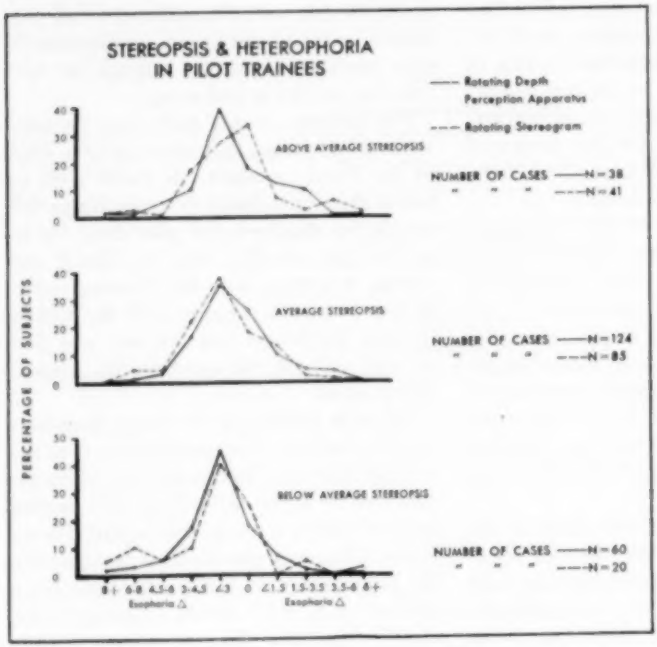

Fig. 1 (Nicholls). Acuity of stereoscopic vision and ocular muscle balance in pilot trainees: esophoria and exophoria are measured in prism diopters. (After Elliot.[80])

to flying performance will be dealt with in Section VI.

He developed his study around a modification of Verhoeff's quantitative test for acuity of binocular stereopsis.[221] He was able to prove that this test for stereopsis was reliable, and that it tested acuity to binocular clues of depth, rather than monocular clues.

In a group of 504 aircrew he found that the "desire for fusion," as measured with the Bishop Harman diaphragm test, correlated closely with amplitude of fusion as measured with the Worth amblyoscope. He found no relationship between fusion, when measured

The findings of these studies show that the methods of examination used by the Royal Canadian Air Force are quite reliable, with the exception of the Maddox rod at near and subjective convergence. A relatively close interrelationship between the various tests also was demonstrated. It was shown that by using these tests in the way described, only very few candidates were rejected for pilot duty. Finally, it was shown that the degree of heterophoria was not related to the refinement of fusion or to the acuity of stereopsis, at least within very wide limits.

(To be concluded)

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NOTES, CASES, INSTRUMENTS

A SPANISH-ENGLISH ACCOMMODATION AND NEAR-TEST CARD USING PHOTOREDUCED TYPE*

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A new accommodation and near-test type card has been designed because there is no known available card of convenient size, having sufficiently distinct small print for accurately determining near vision and amplitude of accommodation. Most of the available print is too large and not sufficiently clear for accurately testing patients with an amplitude of accommodation greater than four diopters.

The Jaeger and Snellen near-vision test cards are not adequate for measuring the punctum remotum of highly myopic eyes. For example, J1 test type subtends a visual angle of five minutes at 450 mm. If a myopic patient of 30D. is tested with J1 at a distance of 33 mm. from the anterior focal point, one with 20D. at 50 mm. and one with 10D. at 100 mm., then the test has shown that the myopic patient with 30D. has a visual acuity of 33/450 or about 20/273; the myope of 20D., a visual acuity of 50/450 or 20/180; and the myope with 10D. has a visual acuity of 100/450 or 20/90, but whether they have a greater visual acuity cannot be determined.[1] This situation is analogous to testing distant vision with a visual acuity chart that has the 20/80 line as the smallest letters.

* Aided by grants from The John and Mary Markle Foundation and The Ophthalmological Foundation, Inc. Technical assistance accepted from and the card distributed by the American Optical Company.

DISCUSSION OF NEAR-VISION TEST TYPES

The first edition of Jaeger's test types was published in Vienna in 1857. The Jaeger system is the most frequently used method of registering near vision at the present time and is generally accepted as a perfectly standardized series of test types. This unscientific system consists of print of 20 different sizes numbered from 1 to 20 according to increasing gradations in their size.[2] Measurements of successive editions have never been constant. Furthermore the character and form of the type have varied from edition to edition.[3] The Jaeger letters are not square, are of unequal diameter (letter and limbs), and mutually dissimilar both in dimensions and definition. The smallest Jaeger print subtends a visual angle of five minutes at 450 mm. which is entirely too large for recording the near point of accommodation of most patients.

In 1862, Snellen produced his chart which satisfied the objections directed at the Jaeger test types. Snellen's letters are scientifically constructed, based upon an over-all visual angle of five minutes with each detail subtending a one-minute angle. The smallest print in the 1866 edition subtends a five minute angle at 450 mm.[4] which is also too large for measuring the near point of accommodation in most cases. Both the Jaeger and Snellen tests are printed; consequently the print could not be made sufficiently small or distinct enough for testing the near point of accommodation in the majority of patients.

Oliver[5] improved upon the Snellen test type for near vision at which time he emphasized its use for determining the range and amplitude of accommodation. He confined his chart to the use of the capital letters—C D E T O L F—which he made into words of one or two syllables each. These letters were chosen because they were deemed the only ones of a formation that accurately

complies with the five-minute and one-minute visual angle system of Snellen. Most significant was the fact that the smallest of the selected words of his chart subtended a visual angle of five minutes at 250 mm. While he made smaller block letter formations, they could not be printed clearly in the usual way because of the small size.

Bjerke[6] was the first to introduce and emphasize the advantages of photographically reduced types for reading tests. The photographically reduced reading tests can be made significantly smaller and more exact than the printed ones.

Lebensohn[7] produced a near-vision test chart by photoreduction. The test type is scientifically correct and very practical for testing near vision which is the greatest advance in a near-vision test since Snellen's original chart in 1862. The smallest letters subtend a five-minute visual angle at 240 mm. Lebensohn's chart is the usual large size and designed essentially for testing near vision at 14 inches.

From a study made in 1918[8] the Duane fine line was selected as the best test symbol for general use. Later, in 1930, the cross was selected as the most suitable test symbol from several prepared in the Department of Physiology of Columbia University (fig. 1). Two previous accommodation test cards were developed by one of us (C. B.), both being designed to determine near visual acuity and range of accommodation and to exercise accommodation.[9,10] The smallest letters were not clear because the card was printed.

Description of New Card

The card consists of English and Spanish words, numbers, the "E" for illiterates and young children and a cross for studying accommodation and astigmatism at the near point. The letters are scientifically constructed according to the Snellen system each letter subtending a visual angle of five minutes. The distance at which the letter should be read in order to subtend a visual angle of five minutes is indicated in millimeters and meters. Some of the test types are designated in the equivalent Jaeger system and Snellen notation to facilitate a comparison with records using either of these meth-

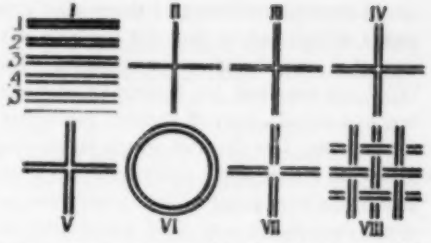

Fig. 1 (Berens and Fonda). Symbols from which cross was selected.

Fig. 2 (Berens and Fonda). A Spanish-English accommodation and near-test type card.

ods. Sentences consisting of the smaller type letters are printed on the card for both testing and exercising accommodation. The "E's" are excellent for testing accommodation and visual acuity of children and illiterate patients. The Spanish words subtending the same visual angle are useful when retesting the near point of accommodation because the subject may have memorized the English word. This card is useful for testing the near vision and measuring the amplitude of accommodation of Spanish-speaking patients (fig. 2).

Construction of new card

The new accommodation and near-test type card consists of photographically reduced type, thus the type is significantly smaller and more exact than the printed test types. Enlarged drawings were made 100 times the size of the test letters, numerals, and characters of the card. The relationship between the overall height of each letter and the diameter of its lines was accurately plotted. From this set of letters, numerals, and characters, photographic negatives were made and reduced 100:10. These negatives were then mounted in a special device used for "photo lettering" which has micrometer adjustments, permitting one letter or character to be printed at a time in its proper position. With this device the words were formed in the manner that type is set. The designed arrangement on this photo print showed all the words, sentences, numbers, and characters but they were all of one size.

From this print, additional photographic negatives and prints were made of the word groups, reducing them to a scale 10 times larger than their final size. These various prints were then pasted on a heavy mount in their correct positions, producing a master card which was 10 times larger than the required size of the actual card. A final photographic negative reduced 10:1 was then made, and from this the final prints were developed. The print was mounted on cardboard measuring 3½ by 6¼ inches, and 1/16th inch thick.*

Methods of use

To test the patient's near point (P.P.) of accommodation in a good light (10 to 80 foot-candles) bring the smallest print the patient can read on the card up to each eye separately, and then to both eyes and note the point in millimeters from the anterior focal point (14 mm. anterior to the cornea) where the first sign of blurring occurs. This test should be repeated three times. Note whether the test is done without glasses or with distant or reading glasses. The point at which the print blurs on the third trial is the numerator. The denominator is the distance at which the print subtends an angle of five minutes.

When prescribing glasses, in addition to the near point or punctum proximum (P.P.), the most remote point or punctum remotum (P.R.) at which the print can be read which is the visual acuity at the near point (nV) and the point of clearest vision or punctum optimum (P.O.) should be noted. The three estimations with glasses should be made with both eyes uncovered.

Acuity of vision for near points and at distant points is identical for normal eyes when the test is properly conducted, due consideration being given to refraction, accommodation, illumination, and comparison of the size of the visual angle. Visual acuity at the near point and at distance is also identical in most eyes having subnormal acuity except in those cases in which the size of the pupil may influence the acuity.[4]

The record of accommodation and near visual acuity in a presbyopic patient could be written in the following manner:

---

* Special photographic nonstretch developing paper such as that used for accurate registration in photo-engraving and lithography was used for all of these photographic prints.

R.E., +1.0D. sph., 6/6; add O.U., P.P., 280/400
L.E., +1.0D. sph., 6/6; +1.5D. sph., P.P., 280/400
nV OU PP-PO-PR/400 280-320-400/400

The accommodation card is valuable for measuring the near vision and amplitude of accommodation with the presbyopic correction the patient may be wearing. This information is helpful when compared with the near vision and amplitude of accommodation with the new reading correction. In this manner one is more likely to prescribe the lenses which will please the patient.

The accommodation card can be used for determining the residual amplitude of accommodation under cycloplegia. A +3.0 diopter lens is placed before the distance correction and then the punctum proximum (P.P.) and punctum remotum (P.R.) are recorded in diopters for each eye separately. The difference between the two readings is the amplitude of accommodation in diopters and for satisfactory cycloplegic retinoscopy and refraction the residual amplitude of accommodation should not exceed 1.0 diopter.

This card may also be used for testing distant visual acuity since the largest print subtends an overall visual angle of five minutes at 20 feet. In the event that the vision is subnormal, visual acuity can be recorded using the greatest distance at which the examinee distinguishes the 6.0 M. on the card as the numerator. If the 6.0-M type cannot be read until the patient is three meters from the card, the vision is recorded as 3/6.

Summary and Conclusions

A new accommodation card of convenient size for determining range of accommodation as well as visual acuity at near is presented. The test type is produced by photoreduction which is the most scientifically accurate method for producing small and exact type. The test type subtends a visual angle of five minutes at distances from 200 mm. to 6.0 M. The card consists of both English and Spanish words, numbers, the "E" for testing vision and amplitude of accommodation of children and illiterates, as well as an astigmatic cross for testing the near point of accommodation and astigmatism for near.

This accommodation card is particularly suitable for accurately recording the range of accommodation in patients of all ages, and with variable degrees of subnormal vision. The 200-mm. test type is almost always distinguished by patients 30 years of age and younger who have normal visual acuity. The near point of accommodation will be found much closer if larger test type is used than type which subtends a visual angle of five minutes at the punctum proximum. The new accommodation card is especially adapted as a near vision test and an accommodation card for precise recordings because of the large range of words subtending a visual angle of five minutes. This card is suitable for accurate testing of patients with high amplitude of accommodation.

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UNUSUAL REACTION FOLLOWING USE OF HYDROSULPHOSOL (1:20) IN CASTOR OIL

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Hydrosulphosol (1:20) in castor oil is favored by some, particularly industrial ophthalmologists, in the therapy of eye burns. Since this agent, chemically sulfhydryl pentathionate, is considered an epithelial stimulant, other ocular uses for it have been suggested.

CASE REPORT

The patient, a white woman, aged 68 years, was a diabetic, controlled by diet and 30 units of protamine zinc insulin once daily, who presented a bilateral corneal epithelial dystrophy, worse in the right eye. Vision was corrected to 20/40 in the right aphakic eye on which there had been a combined intracapsular extraction. Vision was only 20/70 in the left eye due to an immature senile cataract as well as the dystrophy.

The patient had received no therapy in either eye for one week previous to institution of hydrosulphosol. Three days after using hydrosulphosol (1:20) in castor oil in the right eye (the left was a control), there occurred intense conjunctival chemosis, redness, itching, tearing, pain, diminution in vision, photophobia, and lid swelling. In addition, objectively, there was present a diffuse corneal cloudiness, greatest in the periphery, with many peripheral localized infiltrates, seven of which had broken through to form ulcerated areas. There was an associated iritis and vision was reduced to 20/200 for far and near, which is the present visual record.

Under conservative therapy, the eye improved in a few days. Atropine, locally, and benadryl, locally, orally, and intravenously, apparently accelerated the healing process. After one week, no medication of any kind was given.

Meanwhile the slitlamp findings revealed bilateral epithelial dystrophy, bilateral arcus senilis, right epithelial edema, haziness of the entire outer substantia, the multiple ulcerations, a muddy iris with miosis, and cells in the anterior chamber. After therapy, all of these conditions showed improvement. There remained only a slight residual increase in corneal relucency, together with some perilimbal congestion and vascularization, greatest above at the 12-o'clock position.

Approximately one week after cessation of all medication, there appeared a superficial, nonstaining, vascularized pannus above, very similar to that seen as an early epaulette. Laboratory tests were repeated, including the tuberculin and Frei tests, but all were within normal limits. The pannus was superficial and involved with rich vascularization only the outer substantia, Bowman's membrane, and the epithelium. To date all therapy has been ineffective, and there is no improvement except a possible recession in vascularization.

Patch tests were negative to castor oil, severely positive to sulfur in an ointment form, only mildly so to the hydrosulphosol (1:20) in castor oil. Scratch skin tests to sulfur again gave a severe reaction.

CONCLUSION

Allergy to sulfur would seem to show contraindication to the use of this agent and to indicate need for special precautionary measures. Such allergy should be sought before sulfur-containing drops are used locally in the eyes.

321 East Front Street.

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INFECTION OF THE EYELASHES WITH MICROSPORON AUDOUINI

William G. Hopkins, M.D., and Arlington C. Krause, M.D.
Chicago, Illinois

Reports in the literature of cases of ringworm infection of the eyelashes are rare. Costa[1] isolated the fungus, Microsporon felineum, from a Negro boy who had tinea-capitis infection of the scalp, ears, and eyelashes. In a case of fungus infection of the eyelids reported by Silver[2] the etiologic agent was Microsporon audouini, and the diagnosis in this case was made after noting the eyelashes were fluorescent under the Wood's filter lamp. Muskalbilt and Targan[3] reported another case of ringworm infection of the eyelashes which was detected by the use of the Wood's ultraviolet lamp, and they pointed out the importance of examining the eyelashes and brows, as well as the scalp, with the Wood's lamp.

That infection of the eyelashes is rare in association with tinea-capitis infection of the scalp is shown in the work of Montgomery and Walzer,[4] who found only one case of tinea-capitis infection of the eyelashes in 560 cases of ringworm infection of the scalp.

We wish to report a case of fungus infection of the eyelashes caused by Microsporon audouini and successfully treated with roentgen rays.

Case report

Mrs. G., aged 44 years, was first seen in the eye department of the University of Chicago Clinics on March 3, 1947, complaining of a chronic eye-lid infection of both upper and lower lids of five years' duration. Her trouble began following an attack of influenza. Various types of treatment had been tried including sulfa drugs, penicillin, mercuric ointments, systematically and locally, irrigation, and daily massage of the lids with expression of the meibomian glands. All of these varied treatments were worthless, and the patient had had repeated small abscesses of the lid margins from 1942 to 1947.

Examination of the patient revealed that the lower lids of both eyes were thickened and the borders were ruby red. Many of the cilia of the lower lids were absent, and the palpebral conjunctiva was deeply injected and covered with follicles, especially in the lower fornix. The rest of the examination was essentially negative.

Smears and culture of the tears, conjunctival fluids, and scrapings of the conjunctiva were taken from each eye separately and stained with Giemsa's, Wright's, and Gram's stain, but all failed to demonstrate any pathologic organisms. Cultures of the cilia were taken on blood agar and Sabouraud's medium and incubated at 20°C. and 37°C. It is important to note that the cultures of the cilia were obtained by plucking a cilium and inoculating it on Sabouraud's and blood agar. After a period of several weeks the culture inoculated on Sabouraud's medium revealed Microsporon audouini. Interestingly enough, the patient's eyelashes showed no fluorescence under the Wood's filter. The type of fungi isolated from the cilia of the patient was checked by both mycologists and dermatologists, and there was no doubt about the species and type of fungi isolated. Also, the case was presented before the Chicago Dermatology Society and was clinically checked by many dermatologists.

Because of the nature of the infection,

soprǫnal ointment[6] containing propionic acid was prescribed. It has been found that adult hair is fungicidal as compared to children's due to the presence of fatty acids of odd number of carbon atoms in the adult scalp sebum. However, this treatment was ineffective. Roentgen-ray therapy was then ordered. The cilia of the patient were manually epilated and a course of six roentgen treatments to the eyelids were given at weekly intervals. Following this course of treatment the patient has had no more abscesses of her lids and has had no subjective complaints.

Conclusion

The case emphasizes the importance of thinking of a fungus infection in patients with chronic blepharitis. For those ophthalmologists who do not have easy access to a bacteriology laboratory, attention is drawn to an article by Bearnhardt[7] describing a simple culture medium for fungi. Briefly the method consists of placing 5.0 cc. of rice in a 100-cc. bottle and washing it three times with water. Then add 25 cc. of water and 0.8 cc. of 1:1,000 aqueous solution of gentian violet. The bottle is topped with nonabsorbent cotton plugs and is boiled for 30 minutes on three successive days. The media is then ready for use. The bottle is incubated at room temperature, and on this culture Microsporon audouini appear with aerial growth after about two weeks. The colony is seen as a dark-brown flat growth over the surface of the media. Microscopically, curved filamentous threads with no spores are seen.

This case is unusual for several reasons: (1) The patient was treated unsuccessfully by many ophthalmologists with numerous antiseptics because the etiology was unknown and hence the treatment ineffective; (2) the common method of detection of Microsporon by means of the ultraviolet light was valueless; (3) the proper bacteriologic technique is the inoculation of an individual cilium and not the ocular fluids or cells; (4) finally, the proper treatment was the application of roentgen ray and not local antiseptics.

950 East 59th Street (37).

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SOCIETY PROCEEDINGS

Edited by DONALD J. LYLE, M.D.

NEW YORK SOCIETY FOR CLINICAL OPHTHALMOLOGY

January 9, 1950

DR. SIDNEY A. FOX, *president*

PRACTICAL METHODS OF PERIMETRY

DR. ADOLPH POSNER discussed this subject during the instruction period.

BIOLOGIC AND CLINICAL IMPLICATIONS OF CORNEAL RESEARCH

DR. WILHELM BUSCHKE said that corneal research has provided a rational basis for many therapeutic suggestions; for example, in respect to the rate of absorption of drugs, or in respect to possibilities of influencing corneal hydration and of preventing undue corneal vascularization.

In addition, due to its capacity to survive in vitro for considerable time, the cornea is a most suitable object for pathophysiologic experimentation. Much of corneal research has concerned itself with problems of general biologic interest; for example, with the metabolic interaction between the tissue components, with factors determining tissue cohesion, and with factors controlling cell movements in wound healing and mitotic activity of the epithelium.

Several of the methods and approaches developed in this phase of corneal research have found application as biologic tools in cancer research and in studies on the general pathology of radiational damages. This phase of corneal research has proven fruitful also in illustrating some fundamental biologic concepts which have clinical implications beyond corneal problems.

One such biologic concept is illustrated here by some examples from experimental corneal research, namely the concept of rate processes and the related one of the specificity of therapeutic agents.

In vitro experiments with animal eyes and corneas have shown that the clinical, histologic, and chemical changes due to various types of physical and chemical injuries to the cornea (flashburn, mustard gas, cold storage) are in their development markedly dependent on the environmental temperature.

It is inferred that these highly temperature-dependent processes which occupy the latent period between the application of the injurious agent and the manifestation of the damage, are metabolic processes in the tissue itself; they require in some cases oxygen. These examples illustrate the detrimental influence which one may expect from warm applications following these injuries. It is also shown that the cell movements concerned in the healing of epithelial defects following injury are likewise temperature dependent.

The emerging fact, that both desirable and undesirable processes in the tissue are highly temperature dependent, represents apparently a therapeutic dilemma in the use of such unspecific therapeutic agents as heat. However, the same experiments have shown that the degree of temperature dependence, expressed numerically as temperature coefficient of the latent period, is not the same in all of those processes, and it follows that the metabolic processes themselves are not identical.

The differential between various rate processes thus signified leads one to view with optimism the possibility of finding more specific therapeutic agents; that is, agents affecting the rates of desirable and undesirable processes with a higher differential. The degree of specificity of any therapeutic agent may be looked at as a function of this differential. Specificity of therapeutic effect assumes thus a quantitative rather than a quali-

tative meaning, with the antibiotics, for example, being at the top of the scale, and some pharmacologic agents such as atropine, eserine, and adrenalin, being intermediate in specificity.

For these latter agents and for even less specific agents, such as heat, the concept of rate processes makes it a rational therapeutic demand for the clinician to gauge and modify therapeutic results on the basis of closely supervised observation of the patient at frequent intervals.

Correction of congenital nystagmus

Dr. Ernst L. Metzger said that although there is a large literature which deals with congenital nystagmus of the different kinds, there is almost nothing to be found about therapeutic improvement of this fortunately rare condition. He said that, although the visual acuity of most nystagmus patients is below normal, if properly corrected they can be much improved. He cited four cases to illustrate this view.

The first case, that of a man, aged 21 years, showed a pendulant nystagmus in all directions. He had tried many different glasses without much improvement. The right eye had a visual acuity of 20/200; after the correction of a myopic astigmatism of three diopters, he reached 20/80. His left eye was slightly hyperopic and, with and without correction, vision was 20/20−7.

His nystagmus field showed a moderate nystagmus straight ahead, which increased in extent and frequency when he looked to the right and even more for up and down. When he looked to the left the nystagmus came almost to a standstill in the horizontal position. His eyes were almost constantly in the left corner of the lid fissure and his head turned sharply to the right. After correction, his stereoscopic vision was good, and his prescription was combined with prisms on both eyes with base to the right. This improved his condition surprisingly and his ability to do close work was increased considerably. His corrected binocular vision was 20/50.

The second case was that of a girl, first seen at the age of three years, who was almost completely albinotic. In both eyes there was an astigmatism of five diopters. While the iris showed slight pigmentation, the fundus center was almost completely albinotic, and the fovea region anatomically underdeveloped. The nystagmus field showed the largest motions in the left lower field, less in the center, and almost no shaking in the outmost right upper field. When the patient reached the age of five years, Dr. Metzger combined her glasses with prisms of five degrees, in the right eye with base-in and down, and in the left with base-out and down. Here also the effect was striking. The patient now reads without trouble and the distance vision for both eyes is 10/40.

The third case is of a near-sighted boy who, at the age of 14 years, shows: O.U., −10.0D. sph. ⊂ −2.0D. cyl. ax. 180°. His fundi show a moderate conus temporalis but his macula is well developed. He shows in all directions a slow nystagmus horizontalis with a rotatory component which does not change when he looks at distant objects. At the age of 10 years, he was given prisms of three degrees, base-out. The binocular vision improved from 10/100 to 10/40, and the patient is able to read comfortably.

The fourth case is that of an albino girl with a high myopia and astigmatism and a congenital disturbance of her hearing. Her maculas were well developed. She had an alternating convergent squint and, in addition, there was a latent nystagmus pendulans which caused reduction of the visual acuity when one eye was covered. Prisms of seven degrees with base-out were prescribed, and this immediately gave complete relief.

Dr. Metzger concluded that the comfort of patients with congenital ocular nystagmus can be considerably improved by the use of prism glasses. The position of the prism base is to be determined from the nystagmus field, so that the most favorable eye position can be obtained with the least strain. Compensatory head-tilting can be considerably reduced.

In cases in which increased convergence suppresses the nystagmus, prisms base-out

are helpful. In a case of latent nystagmus, prism glasses prevented the occasional manifestation of nystagmus by restoring the binocular vision at all distances.

THE 1:2,000 FIELD IN CHIASMAL INTERFERENCE

DR. MAX CHAMLIN presented a number of cases of mass pressure on the optic chiasm and showed that the field most affected is that for 1/2,000 white. The periphery of this field lies between 10 and 25 arc degrees. Dr. Chamlin introduced the term, intermediate field, for this area. He illustrated the following points:

1. The 1/2,000 field is always affected before the peripheral field and before the immediate pericentral field. With recession of the interference, as by surgical removal of the tumor or successful roentgen therapy of a pituitary adenoma, the peripheral field clears first. The 1/2,000 field is, however, the last to show improvement and very often continues to show defect even with a normal peripheral and normal central acuity.

2. The 1/2,000 field is always involved at least as much as the peripheral and usually more.

3. The 1/2,000 field is much more accurate than corresponding fields for red such as 5/2,000 red for the purpose of following cases of chiasmal interference as with roentgen therapy or after operation.

4. The 1/2,000 field shows changes before visual acuity (Snellen) does and serves as an index of what may be expected to happen to central visual acuity, and is much more accurate in evaluating the central field than the central visual acuity as recorded on the Snellen chart.

Based on the above clinical findings, especially the order of involvement and clearing of the peripheral and intermediate fields, Dr. Chamlin presented his concept of the vertical distribution of fibers in the chiasm. He believed that the ventral portion of the chiasm represents the intermediate field, and the dorsal portion, the more peripheral field.

Such a concept would account for the usual order of involvement at the chiasm in a mechanical manner without postulating greater vulnerability of certain fibers even though more remotely removed from the mass. Dr. Chamlin concluded that the 1/2,000 field is most important in evaluating chiasmal interference due to mass pressure

Discussion. The discussion was opened by Dr. Leo M. Davidoff.

Dr. Smith asked Dr. Chamlin for more specific information regarding the return to normal of the 1/2,000 field.

Dr. Kestenbaum said that the use of colored objects in perimetry should not be discarded. There are conditions in which the sensation for special colors is relatively more damaged than that for white.

The often-used terms, peripheral field and central field, are not very significant because "field" means the outline of the area in which an object is seen and the expression, central outline, would imply a certain contradiction. Practically, however, these terms signify: Peripheral field, for the outlines found at the perimeter; central field, for the outlines found with small objects especially on the tangent screen. The term, central field, should, however, not be confused with central visual acuity. Field refers to the extent of a functioning area; visual acuity, to the intensity of the function within this area.

In the entire extent of the central fovea, each point has a visual acuity of 20/20. If by any reason an exact half of the fovea would be excluded from function, the visual acuity in the preserved half would still be near 20/20. Therefore, we find a vision of 20/20 even in cases of complete bitemporal hemianopia due to interruption of all crossing fibers originating from the temporal half of the macula, since the fibers originating from the nasal halves of the macula do not cross the sagittal midplane of the chiasm.

Only if, in addition to the damage of the crossing fibers, the noncrossing fibers from the macula would be involved, the visual acuity would be affected. This is the case when, in addition to a lesion affecting the chiasm, one of the optic nerves is involved,

such as in arachnoiditis or in aneurysm of an artery, or in a tumor in front of the chiasm. Then we find, in addition to the bitemporal hemianopic disturbance, a more or less severe loss of central vision in one eye.

Dr. Chamlin discussed an intermediate field between 10 to 25 degrees which, in the presented cases, appeared to be of a special critical value. It seems that the lesion in just this area was striking because the examination was done with an object of 1:2,000 which shows the normal outlines of the field in about 20 degrees. If one would routinely use an object of 1:4,000, he would find the critical details in an area of 5 to 10 degrees and defects in this zone would appear as especially significant. Therefore, the assumption of a special anatomic relationship is not required for the explanation of this phenomenon.

Dr. Chamlin said that the first field to go is the peripheral part of the 1/2,000 field.

To Dr. Kestenbaum, Dr. Chamlin replied that, so far as 20/20 vision is concerned, its relationship to the central field is unknown. Regarding objection to the term, intermediate field, he felt that no other relationship can be used. Regarding the use of colors, he said it depended on what kind of white one used; that he had found that, between the 10 to 25 degree area 1:2,000 white shows more than red. As for the time necessary for recovery, he said it depended on the duration of the pressure.

Bernard Kronenberg,
Recording Secretary.

COLORADO OPHTHALMOLOGICAL SOCIETY

November 19, 1949

Dr. Leonard Swigert, *president*

Capsular exfoliation

Dr. W. H. Droegemueller presented the case of Mrs. F., aged 65 years, who consulted him because of poor vision in the left eye. The history was that of intermittent blurring of vision but no pain or redness of the eye.

Corrected vision was: R.E., 20/20; L.E., 20/70. Tension was: R.E., 18 mm. Hg; L.E., 54 mm. Hg (Schiøtz). The anterior chambers were of normal depth. The right visual field was normal; the left showed the typical glaucomatous ring scotoma. The slitlamp showed fine gray flakes of capsular epithelium on the pupillary margin of the left iris. A similar, less-marked exfoliation of capsular epithelium was seen in the right eye.

The question was what to do for the right eye. It was being treated with pilocarpine.

Discussion. Dr. William Crisp suggested eserine every other night to prevent adhesions. Dr. J. Kafka advised immediate intracapsular extraction and cited a case at Colorado General Hospital so treated with excellent result. Dr. George Filmer concurred with this stating that many ophthalmologists believe that capsular exfoliation invariably leads to glaucoma and that proper treatment for any such eye is intracapsular lens extraction regardless of vision of the involved eye. Dr. William Crisp said that he felt that the complications possible in the removal of any cataract contraindicated such surgery until it became unavoidable.

Exophthalmos with a bruit

Dr. Ivan Hix, Jr., presented a case of unilateral exophthalmos with a bruit in a 72-year-old man. The patient had had a "cold" for several months with a watery discharge that had cleared up two weeks prior to the onset of periods of blurred vision. These started 10 weeks before he was seen by Dr. Hix. The blurred vision was followed in a few hours by severe headache that was relieved by lying down. Three days before coming to the University of Colorado Eye Clinic, the patient noted dilated veins about the right eye and a protrusion of the right globe that became gradually worse in the next 24 hours. Vision had been reduced to

light perception. A bruit was heard over the right eye that changed with pressure over the right carotid. X-ray studies had to this point been negative. The patient had been found to have a fasting blood sugar of 242 mg. percent.

Discussion. Dr. J. Kafka suggested Diodrast angiography and stated that a malignancy of the sphenoid sinus can cause venous obstruction.

Phaco-anaphylaxis

Dr. R. C. Richardson presented the case of D. C., a 65-year-old man, with bilateral senile cataract. On July 9, 1948, a right extracapsular lens extraction was performed. The surgical procedure was uneventful. The patient developed a postoperative iridocyclitis for which he received intravenous typhoid vaccine, atropine, and heat.

On May 6, 1949, an extracapsular extraction was done on the left eye and again iridocyclitis developed in the newly operated eye. This responded to treatment.

Three months ago there was a recurrent attack of iritis of the right eye. With each attack the patient has had a complete medical and dental study with no etiologic agent found. Now the patient has secondary cataracts with 1/200 vision in each eye, but not improved with lenses.

Discussion. Dr. J. Koplowitz said that, since this appears to be a case of phacoanaphylaxis, needling should be done with caution. He advised desensitizing to lens protein. Dr. George Filmer suggested the use of an antihistaminic before surgery. Dr. John Egan suggested intravenous nicotinic acid.

Old retinal detachment

Dr. F. Nelson presented the case of Mrs. A. D., a white woman, aged 59 years. This patient was first seen on April 6, 1949. She gave a history of having been involved in an auto accident 12 years before at which time she suffered lacerations of the left brow but no injury to the left eye. The left vision became poor about four years ago. Three years ago she consulted an oculist who told her she had no cataract but that an operation might or might not help her. This information was extracted very recently. The patient had been practically blind for about one year.

Examination showed the right eye to be normal; vision 20/20. The left eye showed a hypermature senile cataract; no fundus reflex was obtainable. Vision was light perception with apparently accurate projection.

The patient was seen again on August 22nd when the County Welfare Department requested removal of the cataract under the Aid to the Blind regulations. The cataract had the same appearance as in April but the light projection seemed to be a little uncertain. The cataract of the left eye was extracted intracapsularly on November 2nd after regular incision with a Graefe knife. No complications occurred during operation. There was no loss of vitreous. The wound was sutured. When the bandage was changed the pupil was somewhat pulled up, otherwise everything seemed all right.

On the sixth day after operation the left eye was examined with the ophthalmoscope and a very extensive old retinal detachment was found. No hole or tear could be detected. The patient was discharged from the hospital on November 10th.

Now the light projection is good and the patient can see hand movements at about one meter. The highest elevation of detachment is about the posterior pole where the detachment looks dark gray suggesting a mass behind it. The vitreous body is not herniated into the chamber; it is dotted with innumerable light-brown pigmented opacities and shows some larger floating opacities in front of the detached retina. Transillumination was performed on November 16th but didn't prove the presence of a tumor. Because the eye had been operated only two weeks previously the transilluminator was not pushed very far backward.

The question is whether there is a tumor behind the retinal detachment or not. The

importance of getting a correct history is stressed.

Discussion. Dr. William Bane wondered how old this detachment was since the patient seemed to have good light projection until quite recently. Dr. William Crisp suggested bed rest to see if a more accurate diagnosis might not be possible. Dr. John Long concurred with Dr. Crisp and further said that transillumination may not be too helpful at this point in differentiating tumor and postoperative choroidal effusion.

Suspected tumor

Dr. William Droegemueller presented the case of J. S., a 44-year-old man, who complained of blurred left vision of six months' duration. Objects were wavy and irregular. Vision had previously been normal. Examination showed vision to be: R.E., 20/15, L.E., 20/100. The right eye was normal. The left fundus showed in the macula an area of greenish gray, somewhat mottled, with glistening drusenlike bodies on its surface. The change from this to the normal tissue was somewhat abrupt. Along the superior temporal vessels was a four disc-diameter area of darker slate gray. This area was slightly raised. It was felt by all who saw this case that the possibility of tumor must be kept in mind. The consensus was against enucleation and in favor of close observation with careful drawings and maps of the lesions to note any change.

Orbital implants

After the case presentations and following dinner, Mr. Fritz Jardon gave an interesting and illuminating lecture with pictures and slides on orbital implants. He traced their history and described the significant characteristics of all including the present day integrated implants which impart such extensive motion to prosthetic eyes.

Thomas M. Van Bergen,
Recorder.

OPHTHALMOLOGICAL SOCIETY OF MADRID

June 24, 1949

Dr. Mario Esteban, *chairman*

Cocaine in ocular therapeutics

Dr. Marin Amat described cocaine's importance in surgery. When the anesthesia is complete, it will, in addition to abolishing the centripetal nervous pathways, similarly affect the centrifugal nervous pathways. This inhibits the so-called axon reflexes which bring about the violent vasodilatory reactions following surgical intervention without anesthesia or with incomplete anesthesia.

He spoke briefly on the use of cocaine in ocular and general therapeutics, mentioned its toxicity on injection, and named other anesthetics of less toxicity.

Perfection of ocular anesthesia in major eye operations may be obtained by a combination of cocaine by instillation and novocain or procaine by injection.

However, this combination of cocaine-novocain is insufficient in certain eye conditions in which there are circumscribed inflammatory regions (hordeolum, scleritis, episcleritis) or in which the edema due to the injection is undesirable (pterygium); or when mydriatic effects of instillation are undesirable, as for instance in exploring the lacrimal passages in cases of acute glaucoma; or when one wants to utilize some properties of cocaine, such as softening the corneal epithelium in cases of corneal tattooing. In such cases the use of cocaine alone produces complete anesthesia and gives perfect control in all procedures.

Discussion. Dr. Mario Esteban said that cocaine, in addition to its anesthetic action, has other topical applications due to its inhibitory action on the corneal epithelium. Such applications are indicated in recurrent erosions of the cornea with rapid and excessive proliferation of the epithelium and in

certain cases of filamentous keratitis, with exuberant growth of the epithelium, in which one wants to inhibit the process of regeneration.

Synchysis scintillans

Dr. Munoz Pato presented a case of synchysis scintillans of the vitreous. A 45-year-old farmer was seen in the public clinic of the provincial hospital on June 23rd. At 11 o'clock on the morning of June 4th, while he was harvesting, he suddenly noticed that the vision of the left eye became foggy with a great many black corpuscles filling his field of vision and causing considerable impairment of vision. There was no trauma and no pain. At examination vision was limited to fingers at one meter and was much worse when the images fell on the temporal portion of the retina. He saw many grayish spots which were rapidly displayed in his visual field in the direction of movement of his eyes.

The right eye was normal. Left eye: lacrimal apparatus, cornea, and palpebral conjunctiva were normal. On the bulbar conjunctiva of both eyes was a small pterygium. Ocular movements, light reflex, sensitivity, and accommodation were normal. Crystalline lens was transparent. The ophthalmometer showed 0.5D. of astigmatism. Retinoscopy showed a "with" movement.

There were numerous brilliant white corpuscles which moved rapidly when the patient turned his eye, appearing as a veritable flood of tiny stars flashing across the red glow in the pupil. Ophthalmoscopy, direct and indirect, showed the same picture, the corpuscles being more numerous in the temporal sector.

The corpuscles in general were spherical, extremely small, and in some positions of the eye appeared as conglomerations which extended for a little distance. Careful examination by direct ophthalmoscopy revealed a few very small hemorrhages "floating" in the vitreous. This would seem to explain the nature of the disease.

First there was the hemorrhage into the vitreous. The synchysis scintillans was produced by some of the chemical constituents of the blood or of the products of decomposition of the extravasated blood (cholesterol). Perhaps there are processes of which we are still ignorant that influence the grouping of these chemical compounds and, by their special physical structure, give rise to the ophthalmoscopic picture here presented.

Joseph I. Pascal,
Translator.

Ophthalmic Miniature

At the manufactory of the Gobelins we see the wools used in the fabrication of the tapestries arranged according to their shades. The number of these shades exceeds 28,000 and yet when we compare two approximate shades we distinguish them with facility, and perceive the interval which separates them.

A. le Pileur, *Wonders of the Human Body*, 1870.

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FIFTY-FIFTH ANNUAL SESSION OF THE ACADEMY

One of the most brilliant meetings of the American Academy of Ophthalmology and Otolarnygology was held at the Palmer House, Chicago, from October 8th to 13th. The total registration was 4,828, only 20 less than the record made last year when Sir Stewart Duke-Elder was the guest of honor.

The president, J. Mackenzie Brown, M.D., of Los Angeles, California, opened the joint session of the scientific section with an able address on "A half century of otolaryngology," in which he reviewed the pioneer work of many otolaryngologists, with emphasis on the Americans who had contributed so much to this specialty. The familiar names he mentioned recalled to many, in a wave of nostalgia, the glorious days of ingenious surgery in this branch of medicine before the discovery of the antibiotics.

The guest of honor this year was the distinguished otolaryngologist, John D. Ker-

nan, M.D., of New York, who later on in the Section on Otolaryngology gave his address on "The pathology of carcinoma of the larynx based on serial sections."

The première showing of the motion picture on the "Embryology of the eye," by Dr. George W. Corner of Baltimore and Dr. George Smelser of New York, was, so far as the ophthalmologists were concerned, the hit of this or any other session so far.

Marvelously planned and beautifully executed, this film, in two parts, revealed the development of the normal human eye from first to last. The picture lasted just an hour and, as the creation of the eye unfolded by means of animated drawings and colored photographs of actual embryologic sections, a skilled narrator explained in clear and concise terms what was going on.

Although sponsored by the Academy, the authors of the film were given entire freedom in the execution of it. Each of these men is an authority in human embryology, and no effort was spared to make the film as accurate as possible. The photography, under the skilled direction of Dwinnell Grant of the Sturgis-Grant Corporation of New York, was superb.

The Academy plans to have copies of the film prepared for sale at a reasonable price to universities and hospitals that may be interested. It is hoped, by this way, to recover, in part at least, the heavy expense of its preparation. It is impossible to say enough about the teaching value of this splendid work. The officers and members of the Academy are very proud of this extraordinary production, completed entirely without the heavy and crushing hand of governmental bureaucracy taking part. There was no dialectical materialism here.

There were several symposia on the program of ophthalmology. The major one on "Corneal diseases," under the able chairmanship of Frederick C. Cordes of San Francisco, covered the applied anatomy and physiology of the cornea by David Cogan, inflammation by James H. Allen, degenerations and dystrophies by F. Phinizy Calhoun, Jr., classification of corneal diseases by Edwin B. Dunphy, and treatment by Kenneth C. Swan.

Another symposium on ACTH and cortisone in ocular diseases gave us important reports by Henderson and Hollenhorst of Rochester, Minnesota, John M. McLean of New York, Sol Rome of Los Angeles, and Frederick C. Blodi of New York, on the extraordinary results of the use of these substances in a variety of ocular diseases, including retrolental fibroplasia and sympathetic ophthalmia. The general use of ACTH and cortisone and the local use of cortisone by instillation and subconjunctival injection were described.

It appears to be the consensus that these substances act on intraocular inflammatory processes by shielding the collagen tissue of the eye as a buffer against the disease process. They do not act directly on the disease process and, when withdrawn, the disease recurs. With each course of treatment, however, the condition of the eye, as a rule, improves. Old pathologic processes are not affected and thus the earlier these substances are used, the better the result. Local use of cortisone seems to be effective and is cheaper to use, simpler to administer, and is free of the danger of serious side effects.

As a background for this symposium, Howard F. Polley of Rochester, Minnesota, discussed the general subject of collagen diseases, and Leonard Christensen of Portland, Oregon, that of the ocular pathology of collagen diseases.

A splendid and illuminating review of the viruses was given by Thomas Francis, Jr., of Ann Arbor, and Perrin H. Long brought us up-to-date on the antibiotics, with particular reference to aureomycin.

The annual Jackson Memorial Lecture was given by Frank B. Walsh, of Baltimore, on "Optic nerve sheath hemorrhage." This splendid essay on a poorly understood sub-

ject will, as is customary, appear in an early issue of the JOURNAL.

Two papers on brucellosis were given. One by Alan C. Woods of Baltimore reviewed the ocular conditions found in this disease. Among them he mentioned nummular keratitis and periodic ophthalmia in horses. The general subject of human brucellosis was completely reviewed by Wesley W. Spink of Minneapolis.

Among the outstanding papers was that by William Banks Anderson of Durham, North Carolina, on fundus changes before and after the rice diet prescribed for hypertensive cardiovascular renal disease. The author conclusively showed, by a series of beautiful colored slides of the ocular fundus, that severe changes, even that of papilledema, found in advanced cases are capable of being reversed by this treatment.

A. L. Kornzweig of New York discussed the pathology of the eye in old age, basing his findings upon the post-mortem examination of 120 eyes from aged individuals. His paper and his scientific exhibition on the subject attracted much attention.

Mrs. Helenor C. Wilder of Washington, D.C., described an impressive series of cases of nematode endophthalmitis. Almost all of the patients were children under 10 years of age, most of whom lived in southeastern United States. The eyes had been removed, clinically diagnosed as retinoblastoma. Her lantern slides, beautifully colored, showed up the nematode larvae in a striking fashion.

Another startling paper was that by L. R. Duszynski of New York in which he showed that 73 percent of eyes removed following glaucoma surgery revealed serious contamination of the wounds with cotton fibrils and talc. He proved that these particles of foreign material initiated an inflammatory reaction in the ocular tissue in each instance. They were invisible in ordinary illumination under the microscope, but were strikingly seen when polarized light was used. There seems to be no doubt that these foreign bodies account for postoperative complications and even failures. The exceedingly high incidence of their presence requires action on the part of each ophthalmic surgeon.

As is recently customary, motion pictures of ophthalmic surgery and clinicopathologic case reports were interspersed here and there throughout the program of formal papers. These are valuable features of the program and, without exception, were well chosen, informative, and illuminating. In addition, a number of new instruments and ophthalmic devices were displayed and described by their inventors.

Of the 22 scientific exhibits, 17 pertained to ophthalmology. The first scientific award was to David D. Donaldson and David G. Cogan of Boston for their exhibit of stereophotographs of the anterior segment of the eye. The second award went to A. L. Kornzweig of New York for his exhibit of the pathology of the eye in old age; and the third award to B. D. Leahey of Lowell, Massachusetts, on transplantation of the cornea. Honorable mention awards were given to W. L. Benedict, Edith Parkhill, and Joseph Groom of Rochester, Minnesota, for their exhibit on gliomas of the retina, and to F. H. Theodore of New York, for his exhibit of office bacteriology of the eye.

One hundred twenty-nine individual courses (including 11 home-study discussion periods) and 32 continuous courses in ophthalmology were given during the week. A faculty of 174 instructors gave 401 hours of instruction. The courses were crowded for the most part, and many of them were sold out.

The daily scientific sessions were similarly crowded, sometimes not even standing room in the main hall, seating 3,000, was available. The eagerness with which the members attended and the long hours of concentration they gave is a remarkable testimony to their thirst for knowledge and to the splendid character of the program.

The new officers elected to serve in 1951 are: President, Derrick Vail, Chicago; president-elect, James Milton Robb, Detroit, Michigan; 1st vice-president, Francis E. Le Jeune, New Orleans; 2nd vice-president, Peter Kronfeld, Chicago; 3rd vice-president, Frederick A. Figi, Rochester, Minnesota. The new councillor is John H. Dunnington, New York.

Members of the Academy will be delighted to know that William L. Benedict has been elected executive secretary-treasurer to serve full time. His election assures us that the magnificent work of this extraordinary organization will continue to thrive under his valuable direction.

Dr. George W. Corner and Dr. George Smelser were elected honorary members of the society in recognition of their outstanding contribution and work on the film of the "Embryology of the eye."

The social side of the meeting was not neglected. The usual smoker and banquet were attended in force, and, at the latter, 10 honor keys were presented to faithful instructors who have devoted many hours to the scientific work of the Academy.

The next meeting of the organization will be held in the Palmer House, Chicago, October 14 to 19, 1951.

Derrick Vail.

WESTWARD HO

The American public is faced with the problem of achieving a better distribution of medical care. An equally pressing problem is that of making available adequate clinical material for the teaching of resident staffs. The fact that no part of this nation or its possessions is now farther away from any other part than two days by air suggests the possibility of transporting doctors still in training to areas where large quantities of clinical material are available and at present inadequately cared for. The work of men still in their residencies must, of course, be supervised by qualified specialists, but this problem, though difficult of solution, need not prove insurmountable.

Last year Duke University and the Alaska Department of Health collaborated in a noteworthy educational experiment in ophthalmology and otolaryngology which may ultimately be extended to other specialties. After completing the first year of the combined residency in ophthalmology and otolaryngology offered at Duke, one of the young residents, Dr. A. W. Vogel, went to Alaska for a six-month period (July 1, 1949, to January 1, 1950) which he spent in the Territory as a clinical ophthalmologist and otolaryngologist under the supervision of a consultant certified in both specialties.

The young doctor's first tour of duty was one month at the Mt. Edgecumbe Medical Center at Sitka where wards of the Alaska Department of Health and the Alaska Native Service come for certain types of special medical care and for certain educational needs that cannot be met in the smaller communities. Here Dr. Vogel, in addition to learning how to carry on his work without the benefit of the equipment available in a large university medical school, was able to participate in a research project on phlyctenulosis which was being conducted under the auspices of the United States Public Health Service.

During the remaining five months, Dr. Vogel worked in 10 widely separated communities throughout the Territory, travelling as far north as Point Barrow, as far west as Nome, and as far south and east as Sitka. He encountered the same types of pathologic conditions which occur in the States but their relative frequency varied interestingly, the high incidence of phlyctenulosis being an outstanding variation. In his report he expressed great satisfaction with his service and with the challenge to his ingenuity.

The success of this first experiment in widening the scope of a university medical center geographically much farther than is

ordinarily considered feasible, suggests one way of reaching larger segments of the population with more and better medical care. What has been done in ophthalmology and otolaryngology could be done in other specialties as well. The problem of supervision is a difficult one but, so far as Alaska is concerned, qualified supervision is at present available in general medicine, phthisiology, orthopedic surgery, and thoracic surgery, as well as in ophthalmology and otolaryngology, and, as time goes on, there will no doubt be an increase in the number of trained supervisors in the Territory.

The Alaska Department of Health, which is under the direction of Dr. C. E. Albrecht, has recently published a brochure describing the residency project, and has offered affiliations in ophthalmology, otolaryngology, or preferably both, to all universities wishing to participate in it. Each affiliation carries a stipend of $200 a month in addition to room, board, laundry, and first-class air transportation to and from and within Alaska.

It is my opinion, and I have observed at first hand the first phase of this residency plan in operation, that the program offers a most unusual opportunity to a young resident, with a spark of adventure in him, to broaden his own experience by living and working in this land of incomparable beauty, and to contribute to the health and welfare of the native people of our last frontier. It should take its place with the Heed fellowships as one of the major extracurricular educational opportunities available to young American ophthalmologists in training.

Phillips Thygeson.

CORRESPONDENCE

Asteroid hyalitis

Editor,

American Journal of Ophthalmology:

I have had the impression for several years that asteroid hyalitis occurs much more frequently in the left eye, although I have never seen anything in the literature to bear out my impression.

Checking over our records, I find that we have had 20 patients showing asteroid hyalitis in a period of 11 years, divided as to eye, sex, and so forth, as follows:

Eye		
O.D.	4	20%
O.S.	15	75%
O.U.	1	5%
Total	20	100%
Sex		
Male	9	45%
Female	11	55%
Total	20	100%
Vision		
20/20 or better	13	65%
20/30 to 20/40, inc.	6	30%
5/200	1	5%
Total	20	100%
Age		
Youngest	45	
Oldest	83	
Average	63	
Race		
White	19	95%
Colored	1	5%
Total	20	100%

Our experience may have been exceptional and for that reason I should like to know the experience of those with a much larger number of cases.

(Signed) Charles A. Young, Sr.,
Roanoke, Virginia.

Physiologic glue

Editor,

American Journal of Ophthalmology:

In the June, 1950, issue of the Journal, two papers were published on the use of thrombin plus plasma in ocular surgery. I have been working on this problem since 1947 and published a paper in the *Klinische Monatsblätter f. Augenheilkunde* (115:4, 1949). I am very glad to be able to corroborate the findings of the Journal authors.

Personally, I use thrombin alone or, more recently, in combination with freshly prepared fibrinogen solution (8 to 13 mg./ml.). With the indicated dilution of thrombin, a coagulation time of half a minute is obtained. The idea of producing a firm coagulum of fibrin between the surfaces in cataract extraction is, in my opinion, a very sound step. The fibrin barrier reduces bacterial invasion. However, rupture of the wound cannot always be prevented.

Introduction of physiologic glue in transplantation of skin, mucous membrane, or amnion represents a further advancement in surgery of the eye. I should like to stress the value of fibrinogen-thrombin combination in order to produce the coagulum, securing firm and prompt healing of the wound. In surgical treatment of retinal detachment this method does not seem to possess any indication.

(Signed) Stephen de Grósz,
Budapest, Hungary.

BOOK REVIEWS

THE ADJUSTMENT OF THE BLIND. By Hector Chevigny and Sydell Braverman. New Haven, Yale University Press, 1950. 320 pages, bibliography, and index. Price: $4.00.

This book is informative and pertinent to the ophthalmologist. Truly, as the authors state, the ophthalmologist's work is in the field of prevention of blindness and only exceptionally with the blind but his contact with those who are treated for blindness or with parents of blind children is sufficiently frequent and certainly important enough for him to have a good background of knowledge about the blind, if for no other reason than to adopt the best psychology possible at the critical time just before blindness intervenes. Actually the authors imply that eye doctors are probably the poorest psychologists among doctors! This is a startling implication demanding careful consideration. If true, the deficiency should be corrected. I was so dumbfounded by the authors' analysis that I plan to write an editorial on this subject to be published in a subsequent issue of this JOURNAL.

The first chapter on adjustment and reorganization is largely an exposition of the problems of the blind with an explanation of the psychologic background. The authors state, "The prime problem of the blind man is independent movement." His economic problem, placed first by many, hinges on it.

Objection is made to the terminology associated with blindness. The difficulties involved are discussed but nothing better is offered. Physical and social adjustment are considered and their independence pointed out. The authors contend that the blind are not a sociologic group and should not be treated as such.

The abilities of the blind are questioned by the sighted ". . . on all four major levels of human endowment—physical, mental, emotional, and moral." The unjustness of this is discussed.

Chapter II is on "The meaning of sight." Man depends mostly on his best sense, that of sight, just as a dog also depends on his best sense, that of smell, but man tends to overestimate the role of vision and ignores evidence supplied by other senses. It is the education of these other senses, rather than any special endowment, that causes the blind to seem to have special powers in them. In teaching the congenitally blind, a serious mistake has been to try to teach in terms of vision, a sense never experienced. The absurdity of thinking that the blind live in darkness or a void is stressed. They are more like a five-cylinder engine in a world of six-cylinder engines, than a six-cylinder engine with one cylinder dead.

An instructive chapter is on the history of the care of the blind. Roughly this is divided into three broad phases: The period of mendicancy from earliest time to about 600 A.D.; of the asylum from 600 A.D. to

about 1750; and of integration, or permission for the blind to take a position in regular society, which is within the last 200 years only.

Probably this problem of the extent to which the blind can be integrated is the biggest puzzle now. The long struggle for acceptance of the blind socially and economically is depicted. Their handicap should not isolate them. That some, perhaps most, need special help is recognized, but the segregation beyond necessity because of blindness is decried by most blind and workers with the blind.

At the Oxford Congress of the Blind of 1949, there was reasonable agreement among them—and they are notorious for disagreement—as to what should be done for them. They labelled the document that evolved at the congress "The bill of rights of the blind."

Great progress has been made, particularly in the changed attitude toward the blind and the assumption of part of their care by local and federal governments. This description of the upward struggle of the blind physically and psychologically is a worthwhile contribution to the subject.

Lawrence T. Post.

RECENT ADVANCES IN THE PHYSIOLOGY OF VISION. By Hamilton Hartridge, M.D., Sc.D. Philadelphia, The Blakiston Co., 1950. 401 pages, 236 illustrations, 39 tables, bibliography, and index. Price: Not listed.

This brilliant text adds to the imposing list of contributions to the physiology of vision made in recent years by our British confreres. Hartridge details at a lively pace the recent advances in this field. Thanks to X-ray technique, both the axial length and the posterior nodal distance have been determined in the living eye. Pure retinene has been prepared by the oxidation of vitamin A to vitamin-A aldehyde. Rhodopsin is probably a polymerization product of retinene. Lawson (1948) made the surprising calculation that normal automatic blinking causes a black-out amounting to 10 percent of our seeing time, and that there is an equal percentage of inefficient vision before and after blinking. Ivanoff (1947) found that night myopia is minimized in atropine cycloplegia, aphakia, and presbyopia and suggests that dark adaptation affects the crystalline lens. Hartridge thinks that another factor may be that, with a reduction of light intensity, the fixation point is transferred automatically toward the parafovea. Stiles and Crawford have proven that the rays which pass through the periphery of the pupil are only one quarter as effective in stimulating the retina as those which pass through its center.

Hartridge introduces throughout the volume his own interpretive comment. He holds that the improvement of visual acuity with increased light intensity is simply due to an increased appreciation of brightness difference. He would substitute for the present standard of visual acuity the cone unit, which is represented by one mm. at five meters distance. This subtends an angle of 41 seconds and is equivalent to Snellen 6/4 or 3.36 microns on the average retina.

The book would have achieved better balance if some of the excessive space devoted to the facts and theories of color vision had been otherwise utilized. Only incidental mention is given to flicker fusion and the clinical, industrial, and military applications of visual physiology. His own polychromatic theory is essentially a synthetic modification of the Helmholtz and Hering conceptions. Hartridge concludes that color is mediated by seven types of receptors acting in three units. Supplemental to the basic tricolor unit (orange, green, and blue-violet) are the subsidiary units, yellow and blue, crimson and blue-green—each unit having its own characteristic distribution and threshold.

The book as a whole is well documented and should prove a valuable aid to both teachers and students.

James E. Lebensohn.

HARVEY CUSHING. By Elizabeth H. Thomson. (With a foreword by John F. Fulton, M.D.) New York, Henry Schuman, 1950. 347 pages, 25 illustrations, index. Price: $4.00.

The life of this complex and fascinating surgeon, written by John Fulton and published a few years ago, was reviewed in the JOURNAL (**30**:83, 1947). The present volume, written by Elizabeth Thomson for the Life of Science Library, condenses in a charming style much of Fulton's material, but handled a little differently. It makes Cushing more human and less the steel-wire technician.

Miss Thomson devotes considerable attention to the part played by Mrs. Cushing who saw to it that her extraordinary husband was sheltered and protected from the storm and stress of family life. The authoress has uncovered new material that adds to the facets of this many-sided character. The book is a perfect gift for the medical student or doctor's son.

Derrick Vail.

A GUIDE TO OPHTHALMIC PHOTOGRAPHY AND ITS APPLICATION TO TEACHING. By Margaret Markham. New York, New York University Post Graduate Medical School, 1950. 85 pages. Price: Not listed.

This collection of lectures on ophthalmic photography were given by the author and others at the New York University Post Graduate School. The lectures have been arranged, edited, and presented largely in outline form. The author states that "the Guide has been prepared with the sole purpose in mind of acquainting the reader with some of the general principles that apply to medical photography, and with a number of specific applications that pertain to photographing the eye and adnexa."

There are eight chapters. The first deals with cameras and accessories and gives the author's views on proper equipment. There are also a number of elementary definitions. The chapter on lighting should be helpful to the beginner and the chapter on sensitized materials gives recommendations for films. Other chapters give techniques of processing. Directions for copying and slide making are brief, while motion-picture making and photomicrography are merely touched upon.

A good bibliography is provided for the reader who desires to investigate the subject more fully.

Edwin S. Wright.

ABSTRACT DEPARTMENT

EDITED BY DR. F. HERBERT HAESSLER

Abstracts are classified under the divisions listed below. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is mentioned only in one. Not all of the headings will necessarily be found in any one issue of the Journal.

CLASSIFICATION

1. Anatomy, embryology, and comparative ophthalmology
2. General pathology, bacteriology, immunology
3. Vegetative physiology, biochemistry, pharmacology, toxicology
4. Physiologic optics, refraction, color vision
5. Diagnosis and therapy
6. Ocular motility
7. Conjunctiva, cornea, sclera
8. Uvea, sympathetic disease, aqueous
9. Glaucoma and ocular tension
10. Crystalline lens
11. Retina and vitreous
12. Optic nerve and chiasm
13. Neuro-ophthalmology
14. Eyeball, orbit, sinuses
15. Eyelids, lacrimal apparatus
16. Tumors
17. Injuries
18. Systemic disease and parasites
19. Congenital deformities, heredity
20. Hygiene, sociology, education, and history

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NEURO-OPHTHALMOLOGY

Dedimos, P., and Calamandrei, G. **Reflex anisocoria; an experimental and clinical study.** Ann. d'ocul. **183**:580-591, July, 1950.

Transient differences in pupillary size caused by abdominal inflammations and degenerations are seldom mentioned in the literature but are more frequent than is generally believed. Anisocoria due to lesions in the neck and chest is better understood because of its closer association with the known sympathetic—parasympathetic cerebrospinal tracts. The authors report and analyze 150 cases of inflammatory or degenerative diseases especially of the lower abdomen with anisocoria in which the right eye was abnormal 24 times, and the left eye 17 times. Among the organs involved were the female generative organs, kidney, liver, pancreas, and lower intestinal tract. Mydriasis was more frequent than miosis. Mechanical pressure or chemical irritation in the abdominal organs is a possible factor. Another factor is pain stimulation from the affected organs. Slight pain causes mydriasis but severe pain produces miosis.

Chas. A. Bahn.

Gorman, W. F., and Brock, S. **Nystagmus: its mechanism and significance.** Am. J. M. Sc. **220**:225-233, August, 1950.

In this excellent review nystagmus is classified as ocular, neurogenic and labyrinthine. In general, ocular nystagmus persists for years or for life, neurogenic nystagmus for months, and labyrinthine nystagmus for days or weeks. In oscillopia, noted only in nystagmus of recent origin, the visual sensation of movement is in the same direction as the nystagmus. Uniocular nystagmus may appear in optic atrophy, spasmus nutans, multiple sclerosis, tetany of the newborn and congenital facial hemiatrophy. Lesions of the brain stem and especially that portion between the vestibular and oculomotor nuclei may induce nystagmus, which when vertical is pathognomonic. Nystagmus in multiple sclerosis, Friedreich's ataxia and syringobulbia seldom disappears. In neurogenic nystagmus the fast component changes with the direction of gaze, the lesion being on the side towards which the amplitude is greater. Miners' nystagmus appears only when the amount of light on the coal face falls below 0.4 f.c.

James E. Lebensohn.

van Husen, Horst. **Differential diagnosis of papilledema in cerebral lues.** Klin. Monatsbl. f. Augenh. **116**:145-152, 1950.

The author diagnosed several cases of papilledema as due to cerebral syphilis when treatment with salvarsan promptly relieved the subjective complaints and made the neurologic symptoms disappear. Another essential diagnostic point was that the pathologic findings in the liquor quickly disappeared after salvarsan. Unless general improvement was noted in the first two weeks the diagnosis of cerebral lues was improbable and cerebral tumor was almost certainly present. It is to be noted that a negative Wassermann reaction in blood and liquor does not exclude cerebral syphilis and a positive reaction does not exclude cerebral tumor. R. Grunfeld.

Morpurgo, F. **Chronic progressive nuclear ophthalmoplegia.** Atti d. 37 Congresso Soc. oftal. ital. **10**:397-402, 1948.

After a short survey of the literature, a case is presented and the differential diagnosis discussed. Frederick C. Blodi.

Okonek, Gerhard. **The chiasmal syndrome. Notes on differential diagnosis, therapy, and prognosis of sellar and suprasellar tumors.** Klin. Monatsbl. f. Augenh. **116**:113-130, 1950.

Bitemporal contraction of the visual fields, bitemporal hemianopsia when fully developed, is the chief symptom of the chiasmal syndrome. If the process continues, central vision suffers, a nasal field defect develops, and primary optic atrophy and blindness result. The chiasmal syndrome is caused mainly by pressure upon the crossed nerve fibers by a growing tumor and must be differentiated from arachnoiditis. Three main groups of tumors are distinguished.

1. Primary intrasellar tumor, pituitary adenoma. Both the eosinophile and basophile adenomas cause a balloon-like distension of the sella. The chromophobe tumor causes even a greater enlargement of the sella, because it grows faster and comes to observation later than the eosinophile tumor with its symptom of gigantism. There is never increased intraocular pressure nor papilledema; this differentiates these from cranial-base tumors and from hydrocephalic enlargement of the third ventricle. The adenomas are very sensitive to X rays. If there is visual loss, surgical procedure followed by X-ray therapy is indicated. If there is no loss of vision, X-ray therapy suffices.

2. Craniopharyngeomas are suprasellar cystic developmental anomalies which originate from dispersed cells of Rathke's pouch. They grow along the base of the skull and may reach the pons. While enlarging they compress the third ventricle, cause internal hydrocephalus, intraocular pressure, and papilledema. The visual fields are irregular and not as symmetrical as in other groups. Endocrine imbalance leads to disturbance of metabolism and of sleep regulation. X-ray films show suprasellar calcium shadows. Craniopharyngeomas are very resistant to X ray. Total extirpation of the tumor is imperative, but in most cases this is impossible because of great extension, involvement of important vessels, such as the internal carotid artery, and the close proximity of the tumor to the heat regulation center.

3. Suprasellar meningeomas grow from the dura of the base of the skull, of the tuberculum sellae, or of the plana sphenoidale. They are firm, fleshy, richly vascularized tumors that extend upward and posteriorly. X-ray films reveal an apparently normal sella. There is no increase in intraocular pressure nor papilledema. This tumor, too, is resistant to X-ray therapy. Total extirpation of the tumor is essential to prevent recurrence.

R. Grunfeld.

Ross, J. V. M. **Functional unilateral mydriasis.** Arch. Ophth. **43**:823-833, May, 1950.

Three cases are presented in which visual acuity was unaffected, but in which the pupil did not react to light and accommodation, and but slightly in convergence. The possible causes of this lesion, which rapidly disappeared, are discussed, and a complete review of the pupillary pathways is included. E. J. Swets.

Stepien, Lucian. **Adhesive inflammation of the pia in the region of the chiasm.** Klinika Oczna **18**:353-374, 1948.

Adhesive inflammation of the pia of the region of the chiasm is considered an independent and well defined pathologic entity. The author discusses its histopathology, etiology, symptoms and diagnosis. Seven cases are described, three of them originated after trauma and one after a frontal sinusitis. All of the patients were operated on. There was one recovery and improvement in all.
Sylvan Brandon.

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EYEBALL, ORBIT, SINUSES

Converse, J. M., and Smith, B. **Case of reconstruction of the maxilla following resection for carcinoma of the antrum.** Plastic and Reconstruct. Surg. **5**:426-431, May, 1950.

Radical maxillary resection resulted in a four-year control in this patient, but the facial deformity, ptosis of the eyeball, enophthalmos, diplopia and consequent psychosocial disturbance were of such gravity as to warrant reconstructive surgery. There was no intrinsic ocular disease or defect in the visual acuity in either eye, but the diplopia was severe and disturbing.

Through an incision extending along the margin of the lower eyelid to a point beneath the medial canthus and curved along the base of the lateral wall of the nose, dissection beneath the gobe was performed. The orbital contents were freed from the cicatricial tissue and the periosteum along the frontal process of the maxilla, the lacrimal crest, and the anterior portion of the zygomatic arch. A piece of iliac bone, suitably shaped to restore the orbital floor, was wedged between the zygomatic arch and no other means of fixation was used. The depression below the orbital floor was filled with cancellous bone chips approximately 1 cm. in diameter; over these another solid bone graft was placed. The muscle layers and edges of the skin flaps were united over this. Pre- and postoperative photographs, a roentgenogram and eight serial drawings effectively aid the presentation.
Alston Callahan.

Hartleib, Robert. **Plastic enucleation and polyviol ball.** Klin. Monatsbl. f. Augenh. **116**:390-397, 1950.

The enucleation of the eyeball must be executed carefully, slowly, and delicately as in any plastic operation. Perfect anesthesia and absolute bloodlessness of operation are prerequisite. The four rectus muscles must be secured with thin catgut in a U-form suture. The eyeball must be carefully dissected without crushing or tearing the tissues. After enucleation the two pairs of muscles must be carefully united over the polyviol ball so that they lie in the same plane for a distance of 4 to 5 mm. R. Grunfeld.

Hogan, M. J., and Dickson, O. C. **Bilateral orbital granuloma simulating a neoplasm.** Tr. Am. Acad. Ophth. pp. 573-577, May-June, 1950.

Approximately two months after a slight injury to the right temple, a negro girl developed a severe progressive exophthalmos, with lid edema and ptosis. Orbital exenteration was performed. The orbit contained a neuromyxofibroma. One year later, exophthalmos developed in the

left orbit coincidental with sinus infection. Transfrontal craniotomy was followed by recession of the exophthalmos and restoration of practically normal vision. A biopsy from the superior rectus and oblique muscles and orbital fat contained only inflammatory tissue. Bodily examinations were negative except for hypothyroidism, the diagnosis of which was based on the basal metabolism, plasma cholesterol, and blood iodine content.

The clinical findings suggest a bilateral thyrotropic exophthalmos coincidental with a true tumor in the right orbit and an inflammatory pseudotumor in the left orbit. (9 figures) Chas. A. Bahn.

Mylius, K. **Thrombophlebitis of the orbita and its treatment.** Klin. Monatsbl. f. Augenh. **116**:246-256, 1950.

The author describes five cases of severe orbital thrombophlebitis complicated by meningitis and cavernous sinus thrombosis. The infection originated from a hordeolum in three cases, from a dental root abscess in one, and from an infection in a small skin wound in the fifth. Only one patient died. In the others the disease cleared promptly after large doses of sulfanilamide and penicillin. In cavernous sinus thrombosis spinal injection of penicillin several times a day may be indicated. R. Grunfeld.

Neuschuler, I., and Malatesta, C. **Pseudoneoplastic tuberculosis of the orbit.** Boll. d'ocul. **29**:53-61, Jan., 1950.

Clinical and pathologic findings in a case of unilateral pseudotumor of the orbit of a 60-year-old woman are reported. The source of the tuberculous metastatic process was in the contralateral lung. (2 microphotographs, references)

K. W. Ascher.

Paufique, L., Guinet, P., and Papillon, J. **The treatment of edematous exophthalmos without hyperthyroidism.** Ann. d'ocul. **183**:449-482, June, 1950.

Present methods of medical and surgical treatment in thyrotropic exophthalmos are anything but satisfactory. The authors report 12 cases in detail in which the marked improvement which followed hormonal and X-ray therapy suggests further investigation of his method. The hormonal treatment is based upon the presumed existence of definite types of both gonadal and thyropituitary insufficiency with defective capillary permeability. The close association of the onset of exophthalmos with abnormal permanent cessation of procreative function strongly suggests that a specific type of gonadal insufficiency is an important factor in the causation of the thyrotropic exophthalmos. Treatment with large doses of estrogens or testosterones is therefore strongly advised. That a specific thyropituitary insufficiency is also a causative factor is demonstrated in the clinical and laboratory tests made. The non-elastic character of the orbital tissues contrasted with the more elastic consistency in thyrotoxic exophthalmos suggests the presence of mucin, which is deposited throughout the body in some types of hypothyroidism. The author advises appropriate treatment of the hypothyroidism with thyroxin, administered with parasympathetic-activating drugs, preferably prostigmine.

The X-ray therapy advised is of the semi-penetrating type and is preferably given at the same time as the hormonal treatment. The total dosage suggested is between 1800 and 5700r in 1 to 3 weeks and the rays are directed both at the orbit and the pituitary gland. Chas. A. Bahn.

Röttgen, P. **A retrobulbar angioendothelioma with pulsating exophthalmos.** Klin. Monatsbl. f. Augenh. **116**:256-262, 1950.

The author describes a case of unilateral pulsating exophthalmos caused by an angiomatous tumor in the orbit. The tumor was demonstrated by X-ray photography

and by angiography. The left bulbus was proptosed to 13 mm. It pulsated synchronously with the pulse. In the left eye a papilledema of 4 diopters was seen. Compression of the external carotid artery of the same side caused cessation of pulsation and diminished proptosis, whereas the compression of the contralateral carotid caused aggravation of the symptoms. The tumor was extirpated by the transfrontal route, which should always be used, for it gives a wider operative field and many angiomas have an intracranial extension. R. Grunfeld.

Vogt, L. G. **Plastic substitute for lost orbital roof to relieve vertical strabismus with double vision.** Klin. Monatsbl. f. Augenh. **116**:262-266, 1950.

A 39-year-old man fell on his face. A lacerated skin wound above the eye became infected and later a frontal sinus operation was made necessary in order to evacuate the accumulated pus. The operation necessitated the removal of a large portion of the orbital roof. After the operation the patient complained of double vision. The eyeball was entirely displaced. The orbital defect was replaced by a plastic roof, the eyeball thereupon regained its normal position and the double vision disappeared.

R. Grunfeld.

Walser, Erwin. **A new plastic implant for prosthesis after enucleation.** Arch. f. Ophth. **150**:414-419, 1950.

The paladon implant had been described in a former paper. The author attaches the four recti muscles to the implant and obtains satisfactory motility of the prosthesis. Ernst Schmerl.

Wright, A. D. **Approach to orbital tumors.** Tr. Ophth. Soc. U. Kingdom **68**:367-375, 1948.

The author describes his method of using the orbital margin as a free graft to be replaced at the end of the operation, which allows a larger opening than the Krönlein or Naffziger's transfrontal operation through the orbital roof. Orbital decompression for malignant exophthalmos due to Graves' disease is also well accomplished by this method. He stresses the need of an accurate diagnosis, and that an air encephalogram should precede all orbital explorations. Beulah Cushman.

15

EYELIDS, LACRIMAL APPARATUS

Bader, Alfred. **Aplasia congenitalis glandularum Meibomi palpebrae inferioris.** Arch. f. Ophth. **150**:411-413, 1950.

One case is described.

Ernst Schmerl.

Cameron, P. B. **Familial ptosis of the eyelids appearing in middle life.** Arch. Ophth. **43**:818-822, May, 1950.

A family group of five generations is presented in which ptosis of the eyelids appeared only in middle life as a Mendelian dominant trait. The pathologic process is evidently a progressive degeneration of the levator palpebrae superioris muscle. No disturbance in the innervation to the superior rectus or in other cranial nerves was noted. E. J. Swets.

Davids, Hermann. **The surgery of senile entropium.** Arch. f. Ophth. **150**:420-421, 1950.

The author obtained satisfactory results from resection of a triangular strip of the skin of the lower lid and removal of some of the fibers of the orbicularis muscle.

Ernst Schmerl.

Eriksen, Arne. **Meningitis after Toti's operation.** Acta ophth. **27**:287-289, 1949.

A woman, 47 years old, developed meningitis after Toti's operation. Pneumococci of the same type were cultured from the nose and spinal fluid. She recovered under treatment with antibi-

otics. A culture from the nose and a roentgenograph of the sinuses should be included in the preoperative study for a dacryocystorhinostomy. Ray K. Daily.

Figi, F. A. **Plastic surgery of the eyelids.** Plastic and Reconstruct. Surg. 5:403-419, May, 1950.

The author describes a unilateral congenital coloboma of the upper lid which he corrected by performing a lateral canthotomy, paring and direct approximation of the margins of the coloboma. He corrects congenital ptosis with fascial slings and recommends Z-plastys for epicanthal deformities.

Hemangiomas may either be capillary or cavernous. The former are either the strawberry hemangioma or the port-wine stain type. Strawberry capillary hemangiomas are best treated in infancy with irradiation, but this form of therapy is contraindicated for the port-wine stain. The latter may be concealed with cosmetics if no thickening of the involved skin is present, or may be removed by repeated partial excision, or excised and replaced with skin grafts preferably in adult life. Cavernous hemangiomas of the eyelids and adjacent structures are most effectively treated with irradiation during the first year of life. For lesions seen later in life, either electrocoagulation or injection of sclerosing solutions is indicated.

When the possibility of malignant change cannot be determined without microscopic study, excision of the entire lesion in one stage is advisable. Immediate plastic repair usually is possible and should be carried out with the use of a pedicle flap from an adjacent area, a free skin graft, or possibly a mucous membrane graft. Large neurofibromas should be excised.

For entropion the author recommends the excision of an ellipse of skin and subcutaneous tissue from the outer surface of the eyelid. Senile ectropion is overcome with cautery perforations or galvanocautery through the conjunctival surface into the tarsus; cicatricial ectropion is corrected with the free skin graft from the upper eyelid of the opposite eye.

In case of excision of large portions of the lid for malignant lesions, the author prefers immediate repair only if the pathologic process is well localized. When more than a third of the lid must be sacrificed, rotation of a tarso-conjunctival flap may be used; with a greater loss, the Dupuy Dutemps procedure utilizing the structures of the opposing lid for the repair may be carried out immediately or after some months. When the author removes an extensive epithelioma involving a portion of the eyelids as well as adjacent structures he recommends that the palpebral remnants be drawn over the globe and sutured to the margin of the wound. This affords an excellent protective dressing for the eye during the period of waiting to determine whether the lesion will recur. In addition it preserves and stretches the remaining portion of the lid which would otherwise contract down to such an extent as to be of little use for plastic repair later. Correction of the operative defect is thus rendered much easier. In the case of malignant lesions about the internal or external canthus which necessitate sacrifice of a third to a half or more of both eyelids, the severed ends of the lids are rotated to permit suturing them together as far as possible. (43 photographs, 6 drawings) Alston Callahan.

Legroux, R. **The technique of using free full-thickness palpebral skin grafts.** Arch. d'opht. 10:367-377, 1950.

The author states that dermo-epidermic palpebral grafts have wide application in ophthalmology, particularly in Morocco where the frequency of lagophthalmos due to cicatricial ectropion is high. He describes in detail the preparation of the bed for the graft and stresses the need for

excision of scar tissue and for employing a graft large enough to allow for subsequent contraction. He obtains the hemostasis necessary for successful takes, by avoiding trauma and ligatures and by using light diathermy coagulation of bleeding points when necessary. The grafts are obtained with the dermatome and are held in place by sutures which in turn are used to hold in place a vaseline gauze dressing, moulded to maintain even pressure over the graft. Penicillin is used to minimize secondary infection. The first dressing is made between the eighth and twelfth days. Legroux closes his report with a consideration of the results he has obtained and with an analysis of the causes of the lesions requiring plastic repair. (19 figures) Phillips Thygeson.

Lisch, Karl. **Carcinomas of the lids.** Ophthalmologica **118**:1010-1016, Dec., 1949.

The author reports the study of 45 palpebral carcinomas treated at the eye clinic of the University of Munich between 1935 and 1941. Histologically 35 were of the basal cell type and 10 of the squamous. Of 18 patients treated with radiation alone, 13 remained clinically cured for five years. The radiosensitivity of a given tumor cannot be predicted from the clinical or histologic findings. The author recommends surgical treatment whenever possible, followed by prophylactic radiation. Peter C. Kronfeld.

Narog, F. **Clinical and pathologic picture of lid necrosis.** Klinika Oczna **18**: 511-520, 1948.

The author discusses the etiology and pathology of necrosis of the lids. He presents a case of necrosis in an infant, three days of age, and three in children. All were due to diphtheria. Autopsy on the infant revealed numerous changes in the internal organs due to diphtheria toxin. Lid necrosis in a 60-year-old woman due to lymphogranulocystosis is briefly described. Sylvan Brandon.

O'Connor, G. B., and Conway, M. E. **Treacher Collins syndrome (dysostosis mandibulo-facialis).** Plastic and Reconstruct. Surg. **5**:419-425, May, 1950.

The Treacher Collins syndrome consists of these associated congenital anomalies: 1. bilateral notching of the lower eyelids, 2. deficiency of the malar bone and infraorbital ridge, 3. lack of cilia of the medial third of the lower lids with oblique palpebral fissures, 4. micrognathia, 5. bilateral deformities of the ears, and 6. bilateral absence of the puncta of the lower lids. Other defects are nasal deformities, malocclusion, absence of the external canal with degrees of deafness, cleft lip and palate and deformities of the extremities. Ida Mann has ascribed most of these major defects to a retardation of differentiation of the maxillary mesoderm at and after the 50 mm. stage.

The notching of the lower lids is corrected by the Wheeler halving operation, and Wolfe grafts and intermarginal adhesions; cancellous bone or a sculptured unit of cartilage is inserted along the infraorbital ridge and malar eminence to correct these deficiencies; a cosmetic rhinoplasty corrects the abnormally large or humped nose; the ears are advanced forward and transposing flaps, Z-plasty and epithelial inlays are used for the construction of the external canal; orthodontic procedures are employed in early life to further stimulate facial development and effect normal dental occlusion. If the patient is not seen until late in life, mandibular section with or without bone graft may be necessary. Additional reconstructive procedures may be necessary to establish facial symmetry.

Alston Callahan.

del Regato, J. A. **Roentgen therapy of carcinoma of the skin of the eyelids.** Radiology **52**:564-573, April, 1949.

The author reports on 168 consecutive cases of carcinomas of the skin of the eyelids and of the canthi, which he saw in six years. Most carcinomas arose from a middle or lateral third of the lower lid near its ciliary border. The next most frequent site was the inner canthus, around or under the caruncle. Eighty percent of this series arose from the lower lid or inner canthus. The growth usually presented well defined limits with no visible ulceration or a small central loss of substance; less frequently it arose from a pre-existing area of dyskeratosis with an ill-defined superficial ulceration. Rarely did the lesions infiltrate the palpebral conjunctiva. The basal cell carcinomas developed slowly. It is pointed out that basal cell carcinomas predominate in areas such as the eyelids, the forehead, skin of the lips and chin; and that epidermoid, or squamous cell carcinomas predominate in such areas as the ears, preauricular regions, temple and dorsum of hands.

The author advises against surgical control of these lesions, believes that the interstitial application of radium has had its vogue and that there is no eye shield which effectively protects the lens against cataract formation as a result of radium application. He gives roentgen therapy for eyelid cancers over a period of three weeks; the usual dose for a basal cell carcinoma is 100 to 150 r repeated each day, sometimes increased to 200 or 250 a day and the total dose is usually about 2,000 r. For a lesion 1.5 to 2 cm. in diameter and a treatment lasting two to three weeks, he usually accumulates 4,000 to 5,000 r calculated at the skin without "back-scatter"; no less than 3,000 r units should be given. Of the 161 patients with basal cell carcinomas, 134 were treated with roentgen rays, 16 received interstitial curie therapy, 9 were treated surgically and 2 refused treatment. In the 16 treated with interstitial curie therapy, two irradiation cataracts and three cases of marked atrophy resulted. There was only one recurrence, and only four patients died. In those cases treated with X ray there were 9 recurrences which were subsequently controlled and no cataracts developed. Of the 7 patients with squamous cell carcinomas, one had a cervical metastasis which was treated surgically and controlled. The other six received X-ray therapy; three of these died of intercurrent disease in less than three years. Three patients, in one of which a preauricular metastasis proved by biopsy developed, remained well three years or more. The metastasis was treated and controlled by roentgen therapy, thus avoiding a facial paralysis.

Alston Callahan.

Schwab, Franz. **Epithelioma adenoides cysticum of the lid.** Arch. f. Ophth. **150**: 388-404, 1950.

In 1,000 patients the author found 40 small tumors of the lid which clinically and histologically could be diagnosed as epithelioma. The histologic picture corresponded to that of syringoma, as these tumors are called by the dermatologist. In 10 of the 40 cases there were similar nodules on the neck and chest.

Ernst Schmerl.

Scuderi, G., and Monciino, N. **The question of trachoma in the lacrimal passageways of discharge.** Riv. ital. d. tracoma e di pat. oculare esotica 1:18-37, Jan.-March, 1949.

An extensive review of the literature and a clinical study of 1,000 cases of trachoma are presented. Seventy lacrimal sacs were examined histologically, of which 44 were in trachomatous patients and 26 in individuals with chronic dacryocystitis. In 16 of the former group histopathologic changes were found which were truly trachomatous. There were hyperplasia and degeneration of the epithelium, many characteristic follicles with

degeneration, and fibrosis. It is possible that the trachomatous process may spread from the conjunctiva to the mucous membrane of the lacrimal sac.

Francis P. Guida.

Souter, W. C. **Auto-eversion of upper lids (voluntary) unaided. Mimical ectropion of upper lids of S. Holth.** Tr. Ophth. Soc. U. Kingdom **68**:207-212, 1948.

A patient, born in 1924, has been able since the age of 12 to evert his upper lids by muscular action with strong contractions of facial muscles but no gaping. At first the maneuver was assisted by finger pressure backwards on the temple. The outer canthi were higher than normal, but the skull, orbit, lids and eyeballs were within normal limits.

Beulah Cushman.

Tóth, Zoltán. **Transplantation of eyelashes.** Klin. Monatsbl. f. Augenh. **116**: 209-212, 1950.

The lid margin is split in the middle between the skin and the tarsus. A narrow strip of skin taken from the eyebrow is placed into this slit. The edges of the wound are sutured with running sutures to hold the transplanted skin between them. R. Grunfeld.

Vannas, Mauno. **Transplantation of lacrimal glands in man and rat; effect of injury of lacrimal duct in rat.** Arch. Ophth. **43**:804-812, May, 1950.

Moderate benefit in one of three eyes in which homotransplantation of the human lacrimal gland was carried out encouraged a study of the operative procedure on the rat. The rat possesses far different lacrimal anatomy than man and the procedures therefore are not directly comparable. In man surgical procedures on the lacrimal gland do not lead to severe ocular complications as they do in the rat. Only a few of the 46 experimental operations were successful, but this may have been due to injury of the excretory duct or other imperfections in the operative technique. Preliminary experiments on section and excision of the lacrimal duct in the rat indicate that this structure may possess moderate regenerability.

E. J. Swets.

16
TUMORS

de Faria e Silva, D. **Cancer of the choroid and detachment of the retina.** Ann. d'ocul., **183**:400-407, May, 1950.

Retinal detachments were observed six times as frequently in eyes with malignant choroidal tumors at the posterior pole as with tumors located more anteriorly. This increased frequency is apparently due to the increased number of vessels in the choroidal circulation of this region. Detachments are caused by transudation due to tumor pressure on the choroidal veins. Based on an analysis of 33 cases, the author concluded that vascularity, pigmentation, size and the histologic character of choroidal malignant tumors have no practical relationship to the frequency nor extent of retinal detachments. Only the location of the tumor is of importance. Chas. A. Bahn.

Klinowski, Czeslaw. **Tumors of the eye in the eye clinic at the Jagiellon University in the years 1940-44.** Klinika Oczna **18**:389-406, 1948.

102 Tumors, 92 of them primary, were seen in the University Eye Clinic in five years. They occurred in 0.27 percent of the total of 38,744 patients.

Sylvan Brandon.

O'Brien, C. S. **Common malignant tumors of the ocular adnexa.** Rocky Mt. M. J. **47**:367-368, May, 1950.

Basal cell and epidermoid types of lid carcinoma seldom metastasize but may invade locally. Wide excision followed by adequate irradiation is the best treatment.

The treatment of malignant lymphoma is by irradiation. Malignant melanomata are treated by excision. In any case of unilateral proptosis, a neoplasm should be suspected, and if a carcinoma is present it usually is secondary to a primary growth in the skin or accessory nasal sinuses which rarely metastasize but are locally malignant. Sarcoma of the orbit is seen in children, and may be secondary. Any type of lymphomatous disease may have malignant lymphomatous metastases. Carcinoma or mixed tumor of the lacrimal gland is not very malignant, but does cause local destruction, and is removed surgically. Bennett W. Muir.

Starorypinska, Maria. **A syndrome of naevi pigmentosi of the face and interior of the eye.** Klinika Oczna **18**:407-413, 1948.

"Naevus coeruleus" is of mesynchymal origin. In a young girl the left side of the face was the site of a bluish naevus which involved the palate and the eye. The iris was covered by small brown nodules, the pupil was fixed, and there was no fundus reflex because of heavy pigmentation. After two years, growth of nodules on the lower lid and in the area of the pupil was noticed. The author compares this case with another one seen 24 years before in an older woman in whom a similar naevus developed into a melanosarcoma.

Sylvan Brandon.

17
INJURIES

Brunner, H., and Bieberdorf, F. **The effects of the mesquite thorn on the human eye.** Tr. Am. Acad. Ophth. pp. 595-597, May-June, 1950.

Mesquite thorn wounds of the cornea and sclera heal imperfectly and frequently become infected. The thorns contain a wax, cerotic acid, and one of the higher alcohols which is very irritating to the ocular tissues. They also frequently contain the fungus alternaria and its spores, which cause infection especially in the uveal tract. The mesquite tree is one of the most frequent forms of vegetation in the southern and western parts of the United States. The author advises prompt and complete removal of the thorn from the eye with minimal trauma, the usual treatment for iritis, anterior chamber drainage if necessary, and the internal administration of iodides for fungus infection. Chas. A. Bahn.

Dunn, K. L. **A preliminary study on "glassworker's cataract" exposures.** Tr. Am. Acad. Ophth. pp. 597-604, May-June, 1950.

Glassworker's cataract is much less frequent than the literature suggests. In past studies, bilateral posterior subcapsular opacities which have been observed in glassworkers have been classified as glassworkers cataract. Now it seems probable that in many of these cataracts, exposure to radiant energy was at most an aggravating factor in cataracts due to other causes. The posterior subcapsular location was explained by the convergence of light rays at the nodal point, which was erroneously assumed to be in the posterior lens capsule. A marked predisposition to this form of cataract apparently exists. Very few cases of glassworkers' cataract could be found at one of the largest glassworks in this country.

Chas. A. Bahn.

Gigglberger, Hans. **Pulsating exophthalmos with a rare sella fracture.** Klin. Monatsbl. f. Augenh. **116**:153-158, 1950.

The following findings were noted 15 months after severe head trauma: right sided facial, acoustic, and abducens paresis, mild protrusion and pulsation of the eyeball, enlarged, broadened scleral vessels. The patient complained of double vision and buzzing noises in the head. The diagnosis of cavernous sinus aneurysm was not made until the X-ray picture revealed a basal fracture and fracture of the

dorsum sella. The internal carotid artery was ligated. The buzzing noises disappeared and the eyeball ceased to pulsate.

R. Grunfeld.

Mejer, F. **Self-inflicted conjunctivitis due to lead acetate.** Ophthalmologica **119**: 221-225, April, 1950.

The clinical picture was that of sharply outlined white lesions in the superficial layers of the tarsal and bulbar conjunctiva. The surface of the lesions was dry, chalk-like. The white material could be removed by gentle scraping, exposing a bleeding base. The surrounding conjunctiva was slightly congested and edematous. The patient, a 27-year-old soldier, admitted having introduced lead acetate into his eye for selfmutilation. A biopsy revealed gray masses in the stroma which could be identified as a lead-protein compound. The lesions finally healed leaving delicate scars. Peter C. Kronfeld.

18

SYSTEMIC DISEASE AND PARASITES

Adda, Victor. **A case of ocular myiasis.** Ophthalmologica **118**:1003-1009, Dec., 1949.

In the anterior chamber of a severely inflamed eye of a 5-year-old peasant boy in Czechoslovakia a fly larva could be identified by means of a loupe. The inflammation subsided after the surgical removal of the larva, but the eye became blind. According to the zoologist's report the larva belonged to the family of sarcophagidae which are commonly known as flesh flies or scavenger flies because they deposit their eggs or larvae on the decaying flesh of dead animals or in open wounds of man.

Peter C. Kronfeld.

Appel, W. **Hypertension and diabetes.** Klin. Monatsbl. f. Augenh. **116**:225-237, 1950.

The author reviews the newest theories of the development of hypertension and discusses the various forms of hypertension and their relation to diabetes. Diabetes may be associated with hypofunction or hyperfunction of the pancreas. In the latter case the pancreas is only secondarily involved as it is unable to respond to the great demand coming from the hyperactivity of the hypophysis and diencephalon. This is true of 70 percent of all diabetics. Arterial hypertension is found in 50 percent of these patients, in 70 percent of women in whom diabetes appeared after the climacteric and in 80 percent of patients with Cushing's diabetes. In those with underfunction of the pancreas, hypertension is found in the same proportion as in the general population, that is, in 20 to 30 percent. Diabetes itself leads to an early aging of the vascular system. The hyperlipemia acts deleteriously when changes of capillary permeability are also present, which is the case in the hyperfunction type of diabetes. Extensive diabetic retinitis is always accompanied by hypertension but single hemorrhages may be present without hypertension. The vascular changes depend on the duration of the disease; 70 percent of all diabetics below the age of 40 years who had diabetes for over 20 years have arteriosclerosis. Diabetic glomerulosclerosis, a syndrome of renal insufficiency, nephrosis, hypertension, and diabetic retinitis develop in 20 to 60 percent of the patients. The end result of this disease is the same as that of malignant sclerosis. In malignant sclerosis the pathologic change is in the arterioles, in glomerulosclerosis in the capillaries of the glomerulus. A diabetic suffers more from cardiovascular-renal disease than from diabetes and the therapy should be planned accordingly.

R. Grunfeld.

Blaustein, A., and Caccavo, A. **Infec-**

tious mononucleosis complicated by bilateral papilloretinal edema. Arch. Ophth. **43**:853-856, May, 1950.

The history suggested the possibility of chronic subdural hematoma. The laboratory data and subsequent clinical behavior confirmed the diagnosis of infectious mononucleosis. Bilateral papillorentinal edema is a rarely observed manifestation of this disease.

Ralph W. Danielson.

Brand, Emmerich. **The ocular tension in myotonic dystrophy.** Ophthalmologica **119**:157-162, March, 1950.

In a typical case of dystrophia myotonica both eyes showed myotonic cataract and low ocular tension. Since the ocular tension rose only 2 mm. during a pharmacologically produced rise in blood pressure from 90/60 to 115/65, the author believes that the low ocular tension was not related to the low blood pressure. After subcutaneous injection of anterior pituitary extract the ocular tension showed a rise, which is the characteristic response of recently castrated animals, whereas in normal animals as well as in man the ocular tension drops under the influence of anterior pituitary extract. The author concludes that the ocular hypotony of patients with myotonic dystrophy is probably related to the testicular atrophy which is a common feature of myotonia.

Peter C. Kronfeld.

Calmettes, Déodati, and Gally. **Ocular toxoplasmosis.** Arch. d'opht. **10**:165-169, 1950.

The authors review the literature on toxoplasmosis and describe the clinical signs of the ocular infection. They report the case of a 10-month-old infant with microcephalus, strabismus, and psychomotor deficiency in which cerebral calcification and patches of central chorioretinitis suggestive of toxoplasmosis were discovered by radiographic and ophthalmoscopic examination. Although serologic proof was lacking in this case, the authors attribute the disease to toxoplasmosis. The fundus lesions are illustrated in color.

Phillips Thygeson.

Christini, G., and Roversi, L. **Protein and lipoid metabolism in some patients with diabetic retinopathy.** Atti d. 37 Congresso Soc. oftal. ital. **10**:566, 1948.

No changes in the protein metabolism could be found. The fat content in the plasma was consistently high.

Frederick C. Blodi.

Czukrász, Ida. **Reiter's syndrome.** Ophthalmologica **119**:99-102, Feb., 1950.

A 21-year-old man was first seen in the clinic with gonococcal urethritis of three weeks' duration, acute gonococcal conjunctivitis of the right eye and acute iritis of the left. Systemic sulfonamide and fever therapy and the usual local therapy succeeded in bringing the conjunctivitis and uurethritis under control. The iritis responded favorably at first but recurred on the twelfth day after admission, and required a second course of foreign protein injections combined with sulfathiazole by mouth. Three weeks after admission the disease appeared to have cleared up at all sites. Five months later the patient returned with mild bilateral conjunctivitis, acute iritis of the left eye, acute inflammation of the left knee and moderately severe urethritis of about two weeks' duration. Various bacteriological tests made at this time proved negative. The author considers the second attack of the disease as a manifestation of bacterial hypersensitivity. Since this second attack consisted of urethritis, conjunctivitis and arthritis, the author suggests that the gonococcus be added to the list

of microorganisms which, by causing bacterial hypersensitivity, can give rise to Reiter's syndrome.

Peter C. Kronfeld.

Grignolo, Antonio. **A heretofore undescribed syndrome consisting of iritis with hypopyon, erythema multiforme exudativum and spondylitis ankylopoetica.** Ophthalmologica **118**:989-997, Dec., 1949.

The paper is based upon the study of one patient who from the age of 25 to 30 years was afflicted with a severe chronic and recurrent ankylosing spondylitis, the outcome of which was a permanent but painless deformity of the lower spine. At the age of 49 years he developed acute iritis with hypopyon and negative bacteriologic findings in the aqueous withdraw on the eighth day of the disease. Under salicylate, sulfonamide, penicillin and foreign protein therapy the iritis subsided, but recurred in a milder form and associated with a skin rash diagnosed as polymorphous exudative erythema one month later. Three months after the second attack of iritis the patient was seen again, with essentially normal findings except for the deformity of the spine. The possible relationship between this syndrome and Behcet's and Stevens-Johnson's disease, on the one hand, and Still-Chauffard's, Reiter's and Marie Strümpell's disease, on the other hand, is discussed. Peter C. Kronfeld.

Grom, Edward. **Bilateral cataract as complication of diabetic cachexia.** Klinika Oczna **18**:483-492, 1948.

Diabetic cachexy and bilateral cataract are described in a 17-year-old girl with sexual infantilism. She weighed 18.4 kgms. and was 135 cm. tall. Her mental development was normal. A general endocrine disorder was recognized and surgery for cataract was not advised. The author discusses diabetes in young people and the cause of formation of diabetic cataract. Sylvan Brandon.

d'Inman, W. S. **The couvade in the England of today.** Ann. d'ocul. **183**:592-612, July, 1950.

Couvade means the manifestations of the maternal urge in the male. This may occur before, during or after birth. In animals couvade is illustrated by the occasional rooster who attempts to hatch a nest of eggs. In humans its occurrence is recorded in the book of Genesis and numerous references occur in history. It is more frequent among primitive peoples, and is a type of psychoneurosis. Among the extraocular functional diseases which have been observed are vascular hypertension, asthma, and gastric dysfunction. Approximately 20 English cases are described in which styes and chalazia occurred coincidentally with an occurrence such as childbirth in persons with this condition. The secretion of the lids which is a secondary sex characteristic may be involved with or without secondary infection in this form of psychoneurosis.

Chas. A. Bahn.

Marchesani, O., and Koch, H. **Cataract and diseases of the middle ear.** Arch. f. Ophth. **150**:329-339, 1950.

Among 19 cases of unilateral cataract the middle ear was affected in 13 patients. In 36 cases of senile cataract only 4 with involvement of the middle ear were found. The anatomic and physiologic conditions suggest that in cases with involvement of the ear the metabolism of the lens is affected, probably through the autonomic nervous system. Ernst Schmerl.

Patz, Arnall. **Ocular involvement in erythema multiforme.** Arch. Ophth. **43**: 244-256, Feb., 1950.

A review of 162 reported cases with lesions of the mucous membranes revealed ocular involvement in 148. Purulent or

membranous conjunctivitis or a combination of the two was the commonest ocular sign. Complications and sequellae of ocular involvement included perforation of corneal ulcers with loss of the globe, symblepharon, scarring of the lids, corneal opacities and keratoconjunctivitis sicca. The author draws attention to a suspected recent increase in the prevalence of mucosal involvement in this disease and reports four cases in detail. To avoid the existing confusion in terminology, the designation of "mucosal involvement in erythema multiforme bullosum" is recommended. Aureomycin has recently been used to advantage. John C. Long.

Radnót M. **Cysticercus in both eyes.** Klin. Monatsbl. f. Augenh. **116**:206-209, 1950.

The left eye of a 43-year-old farmhand was enucleated because of a tumor-like structure in the macula. Later the other eye exhibited a similar lesion which was believed to be a metastatic tumor. However, the histologic examination of the enucleated eye revealed a cysticercus.
R. Grunfeld.

Schmid, E. **Eye symptoms in herpes encephalitis.** Klin. Monatsbl. f. Augenh. **116**: 409-415, 1950.

In a 17-year-old girl herpes zoster was followed four weeks later by encephalitis. The following eye symptoms were noted: paresis of accommodation which disappeared after four months, persistent convergence paresis, and loss of pupillary reflex. The author discusses the relationship of the herpes virus to the encephalitis virus. R. Grunfeld.

Sicé, A. **Ocular disorders due to trypanosomiasis.** Ophthalmologica **118**: 722-732, Oct.-Nov., 1949.

The eye changes in human trypanosomiasis may vary from a mild episcleritis to a severe cyclitis and chorioretinitis. The latter may lead to permanent visual loss. To be distinguished from the eye changes due to trypanosomiasis is the optic neuritis due to tryparsamide intoxication which may set in insiduously or gradually. Peter C. Kronfeld.

Veeneklaas, G. M. H. **Ocular involvement in chickenpox.** Ophthalmologica **119**:96-98, Feb., 1950.

In the Dutch family reported herein chickenpox took an unusual course in that two children developed vesicular lesions at the limbus. The third child had chickenpox twice, the second attack three months after the first. Peter C. Kronfeld.

Witenberg, G., Jacoby, J., and Steckelmacher, S. **A case of ocular gnathostomiasis.** Ophthalmologica **119**:114-122, Feb., 1950.

Gnathostomiasis, that is, infestation of man with larvae of the nematode Gnathostoma spinigerum, is a rare condition of which about 100 cases have been reported in residents of the Far East. The paper under review concerns a white middle-aged woman who migrated from Germany to Palestine in 1935. In December, 1946, she developed the first signs of an illness which five months later was diagnosed as gnathostomiasis when a worm could actually be seeen crossing the cornea. In a propitious moment the worm was removed by keratotomy and identified as Gnathostoma spinigerum. From the clinical symptoms preceding the appearance of the worm in the cornea its path of migration could be reconstructed, namely from the base of the skull to the sella turcica, from there into the left orbit and finally into the sclera and cornea of the left eye. The portal of entry could not be determined with certainty, but ingestion of raw, infested fish was the most likely source. Gnathostoma spinigerum is characterized biologically by its migratory tendency and its relative innocuousness. Peter C. Kronfeld.

19

CONGENITAL DEFORMITIES, HEREDITY

Arkin, Viktor. **Heredity of squint and its importance in the origin of muscle imbalance.** Klinika Oczna **189**:414-431, 1948.

The author discusses 100 cases of squint in 33 of which heredity is established. Anisometropia and amblyopia were found in the majority of children and in 45 parents. Amblyopia and anisometropia are inherited in children whose parents did not squint in their youth. The squint manifests itself in such children after unusual nervous stimulation, such as bombing or serious diseases. Orthoptic training can improve only the acquired component of amblyopia.

Sylvan Brandon.

Cuendet, J. F., and Della Porta, V. **Association of congenital nystagmus with amblyopia and corneal astigmatism. Incomplete sex-linked dominance.** Arch. d'opht. **10**:187-201, 1950.

Cuendet and Della Porta report on a family of 106 members, spread over four generations, of whom 22 or 21 percent displayed a congenital nystagmus. All 22 had a significant corneal astigmatism and all were amblyopic. None of the subjects showed dyschromatopsia, macular changes, albinism, aniridia, retinitis pigmentosa, or other ocular malformations. The heredity was sex-linked and incompletely dominant, the degree of dominance in this family about 50 percent. The female heterozygotes were not nystagmic, amblyopic, or astigmatic. It is suggested that a single gene is concerned, manifesting itself in a triple ocular alteration. Two other families with the same ocular defects are reported.

Phillips Thygeson.

Franceschetti, A., Brocher, J. E. W., and Klein, D. **Mandibulofacial dysostosis with multiple skeletal anomalies and clonic torticollis.** Ophthalmologica **118**: 796-814, Oct.-Nov., 1949.

Under the name of mandibulofacial dysostosis Franceschetti and Zahlen have described a malformation characterized by 1. slanting palpebral fissures with partial colobomas of the lower lids in their external portions, 2. hypoplasia of the malar bone and of the mandible, 3. microtia, 4. macrostomia and other congenital anomalies. Of this condition the authors now report in detail a unilateral case in which the facial anomalies were associated with gross anomalies of the spine similar to those seen in Klippel-Feil syndrome. The case is analyzed from the embryological and genetic standpoint.

Peter C. Kronfeld.

Franceschetti, A., and Klein, D. **The mandibulo-facial dysostosis. A new hereditary syndrome.** Acta ophth. **27**:143-224, 1949.

The authors report six cases of a congenital anomaly, which they describe as a distinct and independent clinical entity under the name of mandibulo-facial syndrome. It differs from the previously described forms of malformation of the cranio-facial bones in the developmental and causal genesis. A review of the literature discloses a number of such cases, which have been reported under a heterogenous nomenclature. It is characterized by an antimongoloid position of the palpebral fissures, and an S-shaped form of the lower lid. According to the severity and symmetrical extension of the syndrome it can be subdivided into complete, incomplete, abortive, atypical, and unilateral forms. The primary cause lies in a disturbance of ossification of the mesodermally-derived facial bones that arise from the first visceral arch, due to an inhibitory process which occurs in the seventh week of embryonic life. The syndrome is of genetic origin and follows an irregular dominant mode of inheritance.

Support of the hereditary origin is seen in the number of somatic and psychic anomalies found in the families of some of the patients. The variability of individual manifestations indicates an unstable gene, and the occasional associated skeletal disturbances suggest that it is pleiotropic. (85 figures) Ray K. Daily.

Godfredsen, E. **Late manifestations of Leber's disease in a hereditary transmitter.** Acta ophth. **27**:429-435, 1949.

Bilateral involvement of the optic nerves and large central scotomas were observed in a woman, 50 years old, who was reported as a normal transmitter in Ruth Lundsgaard's monograph on Leber's disease. The patient's maternal uncle, three brothers and her son have Leber's disease. In her the disease developed ten years later than in her son. There was no change in the enlarged sella turcica, which was demonstrated radiographically 14 years previously, when her vision was still normal.

Ray K. Daily.

Luzzatto, A. **The syndrome of van der Hoeve and psychosis.** Atti d. 37 Congresso Soc. oftal. ital. **10**:449-451, 1948.

The syndrome of van der Hoeve consists of blue scleras, osteopsathyrosis and otosclerosis. This syndrome can occur with various forms of psychopathies. The author reports a family, many members of which had all the signs of van der Hoeve's syndrome. One brother was schizophrenic. He had a hyperexcitability of the vestibular nerve and a lymphocytosis. (References) Frederick C. Blodi.

Pfaendler, U. **A Swiss family with multiple ocular malformations.** Ophthalmologica **119**:103-113, Feb., 1950.

The following ocular malformations occurred in four members of a Swiss family residing in the valley of St. Imier: ectopia of the lens, congenital cataract and conical cornea in two cases; ectopia of the lens, congenital cataract and congenital optic nerve atrophy in one case, and blindness of undetermined nature in the fourth case. Study of the family pedigree revealed several intermarriages within the family. The mode of inheritance was probably recessive.

Peter C. Kronfeld.

Sorsby, Arnold. **The classification of the unassociated dystrophies of the fundus.** Tr. Ophth. Soc. U. Kingdom **68**: 105-113, 1948.

The fundamental ophthalmoscopic feature suggesting a genetic anomaly is the frequent marked symmetry of the lesion in the two eyes with fairly simultaneous onset. The lesions are topographically classified as central, equatorial, peripheral and generalized and the characteristics of pigmentation recognized are mottling, atrophic reaction and the bone corpuscle type. Genetic anomalies may take the form of a congenital structural defect or of an abiotrophic lesion. The author gives a tentative list of clinical entities that have dominant and recessive characteristics.

Beulah Cushman.

Streiff, E. B. **Embryotoxon posterius Axenfeld.** Ophthalmologica **118**:815-827, Oct.-Nov., 1949.

The author proposes the term "marginal posterior dysplasia of the cornea" for the various degrees of the congenital anomaly which is generally known under the term posterior embryotoxon (Axenfeld) and which presents itself biomicroscopically as an annular gray, translucent ledge in the deepest corneal layers, slightly inward from or anterior to the limbus and slightly protruding into the anterior chamber. The normal correlate of this formation is the anterior marginal ring of Schwalbe. The dysplasia is due to the persistence of a normal embryo-

logic formation which is of trabecular and reticulate structure. The milder degrees of posterior marginal dysplasia are common. The more severe ones are usually associated with anomalies of the chamber angle. Peter C. Kronfeld.

Waardenburg, P. J. **Persistent pupillary membrane, anterior polar cataract and microcornea in two generations.** Ophthalmologica **118**:828-842, Oct.-Nov., 1949.

A family with the congenital ocular anomalies indicated in the title is reported in detail. Peter C. Kronfeld.

20

HYGIENE, SOCIOLOGY, EDUCATION, AND HISTORY

Baumann, A. **A short history of trachoma and its treatment.** Riv. ital. d. trachoma e di pat. oculare esotica **1**:14-26, April-June, 1949.

The author presents a short and rapid review of the history of trachoma and its treatment from earliest days to our present days. He reviews the various theories and the methods of treatment of the disease used throughout the centuries.

Francis P. Guida.

Birren, Faber. **Light control vs. light intensity.** Tr. Am. Acad. Ophth. pp. 590-595, May-June, 1950.

In general, illumination engineers tend to exaggerate the effect of variations in the illumination level. Under many circumstances it is far more difficult to arrange the color and brightness of an environment than the light level. A person working on dark material may be troubled by an adjacent white wall even though it reflects less light than the material. The author presents and illustrates a basic principle which pertains to the relationship between the working environment and the task area brightness. Strong contrasts in a working environment require relatively low levels of light to avoid ocular fatigue. High levels are tolerable where contrasts are reduced. In general tasks, reflectancies of 60 percent should not be exceeded except on ceilings.

Chas. A. Bahn.

Foote, F. M. **Growth of the Wise Owl Clubs.** Tr. Am. Acad. Ophth. pp. 605-606, May-June, 1950.

Only those whose eyes have been saved in industrial injuries by the wearing of protective glasses are eligible for membership. This organization is a dynamic force in industrial plants for the promotion of sight conservation. The National Society for the Prevention of Blindness is to be congratulated for its sponsorship of this practical advance in preventing industrial blindness. Chas. A. Bahn.

Herzfeld, Ignaz. **Legal aspects of the loss of one eye.** Ophthalmologica **118**:949-968, Oct.-Nov., 1949.

This is essentially a criticism by a Swiss lawyer of present laws and judicial practices as they apply to loss of one eye in Switzerland. The author has apparently made a thorough study of the problem and quotes extensively from the international ophthalmologic literature. Because of its unusual lucidity and completeness, the author's summary is given here almost verbatim. Damages allowed for the loss of one eye (the other eye remaining normal) are, according to Swiss law, based on the visual needs of the one-eyed person. He receives a compensation of 20, 25 or 30 percent, depending upon whether the work in which he was engaged, requires fair, average, or unusually good vision. These rules are not in favor of the injured person. He must furnish proof that the blindness was the result of an accident, and in case of doubt the law is too rigid, specifically in cases of venous obstruction or retinal de-

tachment following physical exertion. The distinction between the three visual levels in the various occupations is difficult. The amount of compensation received in Switzerland is much lower than in France, Italy, Belgium, Germany and the U.S.A.

The existing laws are particularly inadequate if the second eye becomes affected later on. According to the law, damages for partial or complete loss of the second eye are allowed only if this loss is a direct consequence of the first injury, that is, due to sympathetic ophthalmia, or if the loss is the direct consequence of a second injury.

"More often it happens that the second eye which was previously normal, becomes the site of a disease which bears no relation to the original injury. From an economic point of view this would not be important if this were not the patient's only eye. One is justified in regarding these cases (of disease of the second eye) as an indirect result of the original accident. There exist sufficient grounds for requesting that the damages paid to a one-eyed person be amplified to include the second eye. This was realized in a postulation formulated by the Swiss Ophthalmological Society a quarter of a century ago and it is now of new interest for further legislation."

Peter C. Kronfeld.

Starkiewicz, Witold. **Results of mass examination of vision in school children of Warsaw.** Klinika Oczna 18:450-463, 1948.

13,725 school children were examined and abnormal vision was found in 11.7 percent. Of these 31 percent were hyperopic, 19 myopic, 32 astigmatic, 13 had monocular failure of vision, and 4.8 had other defects of the eyes. Use of glasses decreased the percentage of children with poor vision to 8.1 percent of the total.

Sylvan Brandon.

Stern, E. S. **The psychiatric aspect of miners' nystagmus. II.** Brit. J. Ophth. **34**: 385-390, June, 1950.

The author concludes that miners' nystagmus is chiefly an emotional disorder of the older men, brought on, most often, by anxiety and inability to cope with the work. In countries where no compensation was paid for miners' nystagmus, there were very few cases.

Orwyn H. Ellis.

Stoeckli-Bay, V., Sicé, A., Perret-Gentil, A., and Brueckner, R. **Eye examinations of Dutchmen interned during the last war.** Ophthalmologica **118**:775-780, Oct.-Nov., 1949.

Eye examinations of 238 Dutchmen, residents of the Dutch East Indies interned by the Japanese during the last war, revealed in about one third of the cases, pathologic changes such as temporal pallor of the disc, absence of the foveolar reflex, "granular" macular regions and central scotomas for colors. The cause of these changes which are usually comprised under the term "camp eyes" is still not definitely established.

Peter C. Kronfeld.

NEWS ITEMS

Edited by Donald J. Lyle, M.D.
601 Union Trust Building, Cincinnati 2

News items should reach the editor by the 12th of the month but, to receive adequate publicity, notices of postgraduate courses, meetings, and so forth should be received by the editor at least three months before the date of occurrence.

Deaths

Dr. Joseph Edward Golding, Brooklyn, New York, died July 27, 1950, aged 72 years.

Dr. Harry Carleton Messinger, Providence, Rhode Island, died August 2, 1950, aged 68 years.

Dr. Ralph Edward Russell, Ocala, Florida, died July 16, 1950, aged 45 years.

Announcements

Course on ocular pathology

The Tulane University of Louisiana School of Medicine, 1430 Tulane Avenue, New Orleans, Louisiana, announces a course in ocular pathology devoted to a study of tumors of the eye, adnexa, and orbit, to be given from February 12 to 17, 1951, inclusive. The fee for the course, which will be limited to an enrollment of 12, is $100. Assisting the regular staff will be Dr. C. S. O'Brien, Dr. John McGavic, and Dr. Theodore Sanders. Further information may be obtained by writing to Dr. James H. Allen, Department of Ophthalmology, 1430 Tulane Avenue, New Orleans, Louisiana.

Symposium on pharmacology and therapeutics

From February 19 to 24, 1951, inclusive, a symposium on ocular pharmacology and therapeutics will be held at The Tulane University of Louisiana School of Medicine, 1430 Tulane Avenue, New Orleans, Louisiana. Limited to 150 registrations, the fee for the course will be $100. Dr. Alson E. Braley, Dr. Parker Heath, Dr. Irving H. Leopold, Dr. P. Robb McDonald, Dr. Frank W. Newell, and Dr. Alan C. Woods will assist the regular staff in conducting the symposium. For further information write to: Dr. James H. Allen, 1430 Tulane Avenue, New Orleans, Louisiana.

Toronto refresher course

The University of Toronto, Faculty of Medicine, announces a combined Refresher Course in Ophthalmology and Otolaryngology during the week of January 29 to February 3, 1951. Dr. Phillips Thygeson, University of California School of Medicine, and Dr. Charles E. Iliff, Johns Hopkins University, will be guest speakers in ophthalmology. Dr. LeRoy Schall, Harvard University, and Dr. G. F. Tremble, McGill University, will be guest speakers in otolaryngology. There will be surgical and medical clinics in these two subjects in addition to lectures by members of the faculty.

The course will be given for a minimum of 10 students and a maximum of 25 students. Application may be made to the Dean of the Faculty of Medicine not later than November 30, 1950.

Residency open

A residency in ophthalmology is open at Jefferson Davis City-County Hospital, Houston, Texas, beginning January 1, 1951. A basic course is required. Applicants please write Dr. E. L. Goar, 1300 Walker Avenue, Houston 2, Texas.

Eye bacteriology laboratory

An eye bacteriology laboratory has been started at the Banting Institute in the Department of Ophthalmology, University of Toronto. The laboratory is under the direction of Dr. H. L. Ormsby assisted by Dr. G. G. Cousineau who has been appointed a Hermant Fellow.

The laboratory will serve in close liaison with the departments of ophthalmology and bacteriology. Ophthalmologists may refer their private cases to the laboratory for bacteriologic investigation.

Grants for ophthalmic research

The National Council to Combat Blindness, Inc., is accepting requests for grants-in-aid for ophthalmic research for the period July, 1951, to June, 1952. Applications should be received at the office of the council not later than March 1, 1951. For further information and appropriate forms write to: Secretary, National Council to Combat Blindness, Inc., 1186 Broadway, New York 1, New York.

Florida seminar

It is announced that the fifth annual University of Florida midwinter seminar in ophthalmology and otolaryngology will be held at Miami Beach from January 15 through 20, 1951. Details of the program will be published in the next issue of the Journal. In the meantime, further information may be obtained by writing to Dr. Walter T. Hotchkiss, 541 Lincoln Road, Miami Beach, Florida.

NSPB research grant

The National Society for the Prevention of Blindness has announced a research grant of $2,500 to the New York University-Bellevue Medical Center to help solve one of the most perplexing mysteries now facing ophthalmologists and pediatricians—the sudden increase in the number of premature infants

being blinded by the eye disease known as retrolental fibroplasia.

Societies

Society of the United Kingdom

The annual congress of the Ophthalmological Society of the United Kingdom will be held at the Royal Society of Medicine, 1 Wimpole Street, London, W.1, on March 29, 30, and 31, 1951. The subject for discussion, "The association of ocular and articular disease," will be opened by Mr. L. H. Savin, Prof. G. W. Pickering, Dr. F. Dudley Hart, Mr. A. B. Nutt, and Prof. E. J. Wayne. Members who wish to take part in the subsequent discussion are advised to intimate their intention before the opening of the congress. It is emphasized that no member may speak for more than 10 minutes.

On this occasion, the Bowman Lecture will be delivered by Sir Henry Dale, O.M., G.B.E., M.D., F.R.C.S.

Gill residents meet

The first annual clinical conference of the Gill Memorial Eye, Ear, and Throat Hospital for former residents was held at the hospital, September 18. The following papers were presented:

"Refractions," Dr. W. J. Judy, East Rainelle, West Virginia; "Management of crossed eyes," Dr. R. M. Ferrell, Lewisburg, West Virginia; "Technique for removing an eye," Dr. F. Buerk Zimmerman, Louisville, Kentucky. Case reports were given by Dr. R. E. Smith, Mount Airy, North Carolina, and Dr. Keith Gerchow, Morgantown, West Virginia.

The following officers were elected for the year: President, Dr. F. B. Zimmerman; 1st vice-president, Dr. Keith Gerchow; 2nd vice-president, Dr. R. M. Ferrell; secretary-treasurer, Dr. Houston L. Bell. The next meeting will be held the last week in September, 1951.

Brooklyn meeting

Dr. Irving H. Leopold, Philadelphia, presented a paper on "Recent advances in glaucoma therapeutics," at the 113th regular meeting of the Brooklyn Ophthalmological Society. Officers of the society are: President, Dr. Mortimer A. Lasky; vice-president, Dr. Daniel Kravitz; secretary-treasurer, Dr. Louis Freimark; associate secretary-treasurer, Dr. George A. Graham.

Washington society's schedule

The dates of the meetings of the Washington, D.C., Ophthalmological Society for the 1950-1951 season are: November 6, 1950, and January 8 and May 7, 1951. During the month of March, there will be a joint meeting with the Baltimore Ophthalmological Society, the date of which will be announced later.

Officers for the society are: President, Dr. Thomas A. Egan; vice-president, Dr. Everett S. Caldemeyer; secretary-treasurer, Dr. Joseph Dessoff; directors, Dr. J. Spencer Dryden and Dr. J. Thomas Schnebly.

Personals

The appointment of Dr. John S. McGavic as ophthalmologist to the Pennsylvania Hospital, Philadelphia, was announced recently.

Dr. McGavic, who resigned his post as an associate professor of ophthalmology at Temple University Medical School to assume his duties at Pennsylvania Hospital, is also attending ophthalmologist of the Bryn Mawr Hospital, assistant pathologist at the Wills Eye Hospital in Philadelphia, and assistant professor of ophthalmology at the Graduate School of Medicine of the University of Pennsylvania.

Dr. McGavic maintains his private practice at 601 Montgomery Avenue, Bryn Mawr, Pennsylvania.

Dr. Arthur G. De Voe has been appointed professor and chairman of the department of ophthalmology, New York University Post-Graduate Medical School, a unit of the New York University-Bellevue Medical Center. He will be in charge of all ophthalmologic teaching, research and patient care at the center.

For the past 10 years Dr. De Voe has been a member of the staff of the Institute of Ophthalmology, Presbyterian Hospital. He served in the medical corps of the U. S. Army during World War II and was discharged with the rank of major. Since 1946 he has been senior consultant at the U. S. Veterans Administration Hospital, the Bronx. He was graduated from Columbia University with the degree of Doctor of Medical Science in 1940 and from Cornell University Medical School as an M.D. in 1935.

At the XVI International Congress of Ophthalmology held in London July 17 to July 22, 1950, there were five presentations dealing with the aqueous veins. In the Scientific Exhibition, Dr. K. W. Ascher, Cincinnati, showed the present status of the biomicroscopically visible aqueous-humor elimination; Dr. Norman Ashton, London, exhibited neoprene casts of Schlemm's canal, showing the origin of aqueous veins. On the program of papers presented to the congress, were the lectures of Dr. K. W. Ascher, Cincinnati, "Aqueous veins and contact lenses;" of Dr. Hans Goldmann, Berne, "The other ways of outflow of the aqueous chamber," and Dr. Nicolas Trantas, Athens, "On the nature of the aqueous veins of Ascher."

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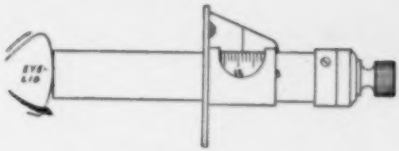

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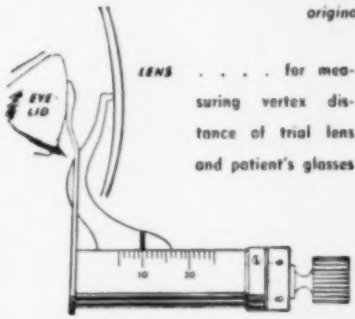

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